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Engineering News-Record

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May 15, 1919

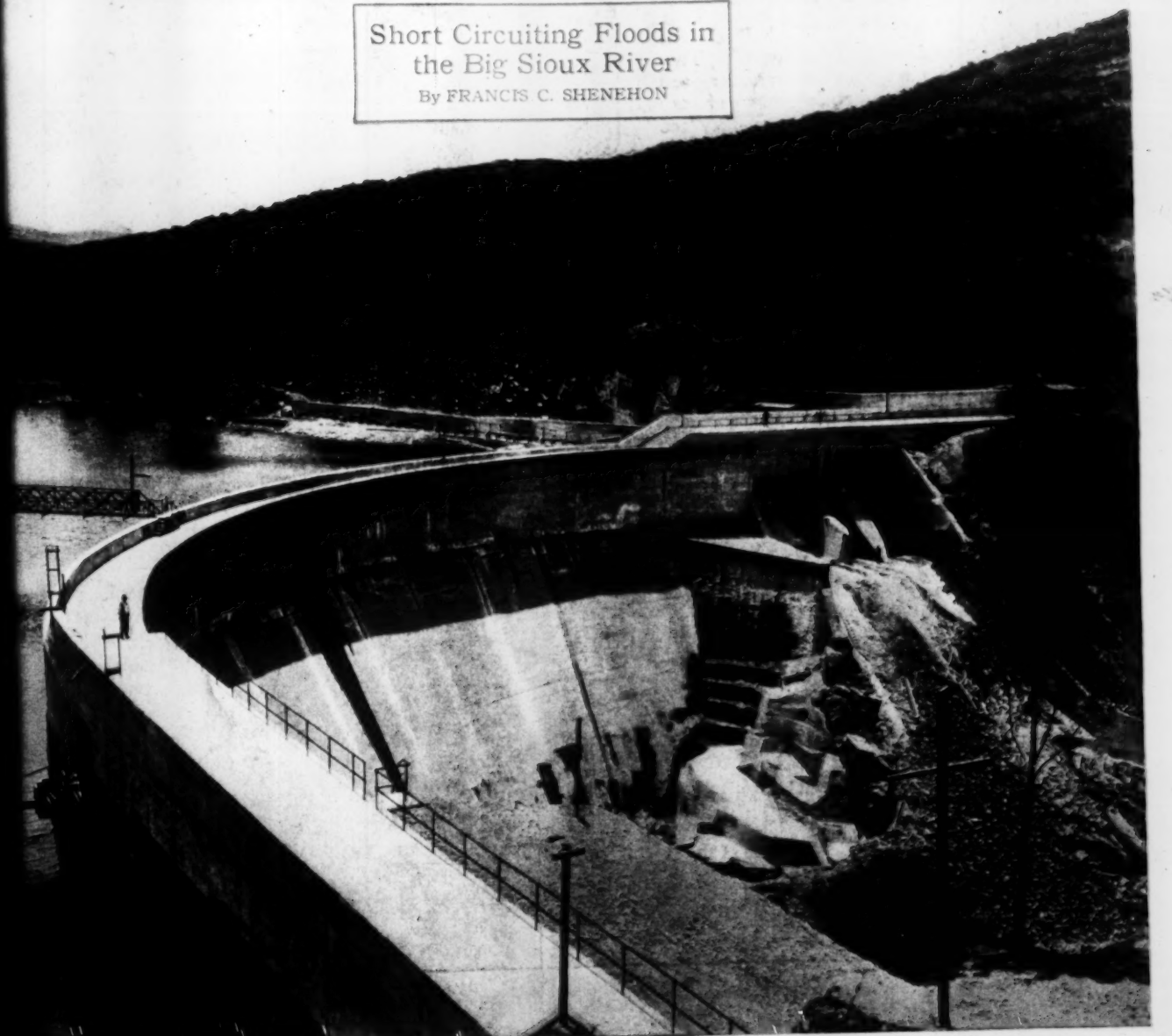
Sweetwater Dam Enlarged for the Third Time

By H. N. SAVAGE

Demobilizing Equipment of Spruce Production Division

Short Circuiting Floods in the Big Sioux River

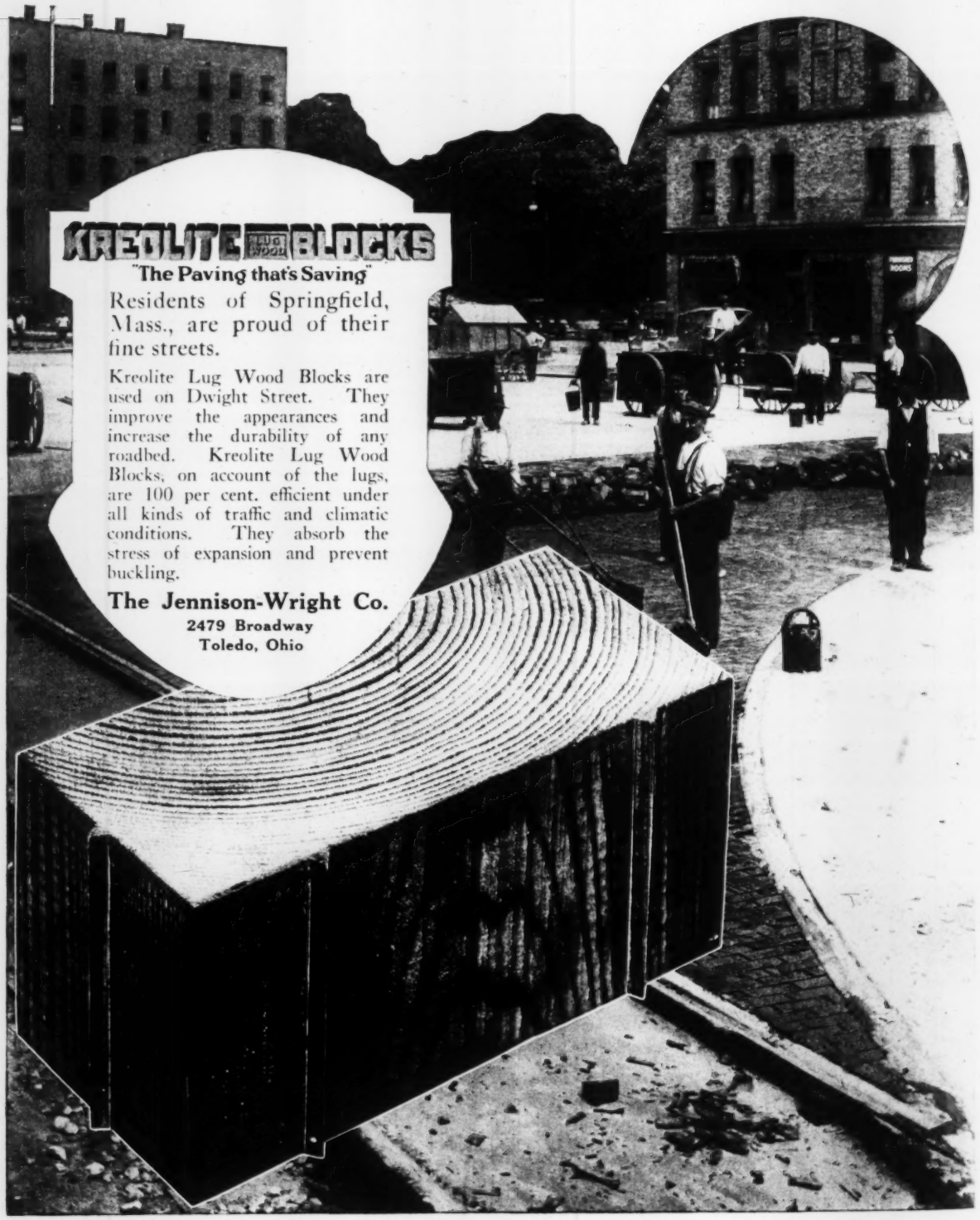
By FRANCIS C. SHENEHON



Looking Across Sweetwater Dam Canyon from above New Siphon Spillway Towards Weir Spillway

KREOLITE LUG WOOD BLOCKS

"The Paving that's Saving"



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Danger in Thawing Concrete

THAWING out a frozen surface of concrete with the warm concrete which is to form the next layer in the mass seems to have been practiced successfully in two recent dams, but the engineer's testimony on another page is noted there as a record, not as a recommendation for general practice. For a superficial, recent surface freezing such a scheme may work, but the probabilities of stratification due to delayed setting or reduced strength would point to the greatest care in using this method where weak horizontal planes might threaten future danger.

Hauls for Export Freight

PORTS are essentially national institutions. No matter how extensively they are financed by the city or state where they are located, or how largely they benefit that city or state, their fundamental purpose is to link up domestic and foreign trade centers. Too often this has been forgotten and the port has been developed as an isolated unit, in the hope that time would force both land and water trade routes to utilize its mechanical or possibly geographic advantages. A superior line of attack is that indicated in the analysis of the Mississippi Valley possibilities by J. R. Bibbins, on another page, where trade is studied as a unit from the American consumer to the foreign producer or vice versa, and the whole rate structure—on land and on sea—analyzed, not with a view of promoting any one port, but with the idea of so distributing the foreign trade movement as to produce the most economic through carriage of freight, regardless of local advantages. As was pointed out in these columns some months ago, this requires national thinking and doing in transportation matters, and surely the time came long ago when this was necessary. Persistence in the old policy has been wasteful.

Selling the Spruce Equipment

LIKE a tragedy of the great war, the sudden demise of spruce-production activities in the Northwest at first seems the untimely ending of a promising enterprise. In the Vancouver cut-up plant, so recently teeming with workers, there is now the dead silence of a great warehouse. The sharp contrast is to the engineer-visitor a persistent suggestion that something must have gone wrong. But this is only the illusion that may arise when military activity enters the field of engineering. An abandoned project from the engineering point of view does indeed suggest an untimely ending, but military endeavor runs in a different channel—one in which sudden interruption often indicates attainment of purpose. It was so with the Spruce Production Division. Its work was well planned and consummated with skill. Now that its military purpose has been served, a most commendable policy is directing the closing up of affairs in such way as to interfere as little as possible with trade conditions in the Northwest. To dump $10,000,000 worth of equipment and materials on the market at cut prices would have demoralized local conditions for years to come. Yet disappointed bidders turned upon the spruce corporation with bitter criticism when offers below market values were rejected. Rumor spread that at Vancouver Barracks there was a "junk pile" where brokers were profiteering at the purchaser's expense. Nothing could have been farther from the truth. The orderly array of equipment and the systematic records of the stock are truly surprising, when the difficulties under which it was handled are considered. The Secretary of War and the Chief of Staff on a recent inspection visit commented on the care that the equipment had received and the splendid condition in which they found it. First and last the soldierly precision that has characterized the spruce-production work warrants a "well done."

Responsibility for Tank Failure

NO NEW technical teachings are found in the circumstances of the Boston molasses-tank failure recorded in this issue. The case was simply one of a structure designed and built too weak for its service; it was not more than half as strong as it needed to be. Engineers know thoroughly well how to build tanks so that they will be safe, and they have nothing to learn, therefore, from the manner of failure of this scamped piece of construction. But they may well learn, or try to learn, in another respect. It is evident that they do not know how to make sure that their technical skill and knowledge will be applied to the use of the community. They have failed in not creating conditions such that only safe engineering structures can be built in Boston—or, for that matter, in any other city. The blame for this rests on the engineering profession, for in the long run the safety of structures that may endanger life and property is the concern of the engineering profession as a whole. Where does the responsibility lie and how is it to be made a means of protecting the public? Courts of law will be called upon to consider the case, and they will doubtless attend to the responsibility of the men who built the tank; of those who, while supposedly guarding public safety, allowed it to be built, and of those who put the tank to use and continued to use it in spite of the fact that they might and should have known its dangerous condition. But, beyond this, there is the further question of engineering responsibility. Was an engineer concerned in the construction of the tank? Did this engineer jeopardize the reputation of the pro-

fession by grossly faulty work, or perhaps by yielding technical authority to an incompetent superior? Or, did state and city permit a dangerous structure to be erected without the assurance that an engineer's skill and science had been applied to it? Finally, does the name engineer in Boston mean either competence or responsible authority? Questions such as these go to the very heart of some of the conditions now agitating the profession, and give substance to discussions of professional regulation, of the obligation of competence, and of the need for group action by engineers.

The Professional Conscience

SURELY the malpractice of whatever engineers were connected with the fatal molasses tank is a matter of personal concern to the technical community, just as definitely as a lawyer's malpractice is of concern to the legal community wherein he labors. There is such a thing as a professional conscience, and it is rooted in the simple but compelling truth that the reputation and the livelihood of every member of the profession depend on the good conduct of every other member. Lawyers have organized bar associations to be custodians of the legal conscience. But who is the custodian of the engineering conscience? When we study this question carefully, and find an answer, we shall have set a signpost that, in the confusion of movements for local, state, national and ultra-centralized organizations, points unmistakably to the ultimate unit of structure in the professional community—the local group.

Output Versus Wages as the Contractor's Problem

CONTRACTORS need to spend more time in developing output and less time in deploring high wages. When two or three are gathered together, the wage topic soon takes precedence. Wages are high and they will continue high. Output has not climbed with wages; it has slipped back. The problem is clear. What contractors have to do is not merely to *talk* about the worker's wage demands but to get busy increasing his output. The modern method of procedure is to enlist the worker's interest and coöperation—just what the big industrial organizations, like the White Company, the Standard Oil Company and others, are now trying to do. Action along constructive lines is to be expected of strong men; grumbling is not.

Methods of increasing output are available. One hesitates nowadays to mention scientific management; its fanatic disciples have made the name a jest among contractors. Nevertheless, the reasonable professors of this "science" have developed ways of increasing the output of workmen. Some of these ways are being employed partially. The workman has been the chief obstacle to their general adoption, for two principal reasons: The practices were imposed from above and aroused the workman's resentment against dictation, and the workman saw in these practices only an attempt to increase production without an adequate increase in remuneration. The workman's conclusion may not have been justified. The important fact is that such was his conclusion. Again, the task of the contractor is to meet the condition and not to deplore its existence.

The coöperation of labor in devising better methods has seldom been formally enlisted. Instead, the plan has been formulated by the employer and imposed by declaration, and labor was expected to espouse the reform with zeal. It did not. It will not do so, and it cannot be expected to de so without the conviction which the employer has of the need and the benefit of the plan and the further conviction that labor will become a direct beneficiary. Labor's attitude is largely justified. Without similar understanding and assurance the contractor would not accept a declaration by the owner of, say, a new method of estimating monthly payments.

Labor will help to increase production if it is made to understand the necessity and is assured a share in the gain. This is not the statement of a visionary; too many contractors are demonstrating its possibility for it to be successfully denied. As an example, the statement by J. B. Lippincott in *Engineering News-Record*, of Mar. 27, 1919, p. 605, may be noted. With the necessity for increasing output put squarely before the unions, Mr. Lippincott reports that they "took a keen interest in assisting in improving unit costs." Similar testimony is given by word of mouth from other construction managers. Contractors cannot logically complain of labor inefficiency until they have tested the worker's response to this sort of treatment. The spirit of coöperation will be found latent in a greater number of union labor leaders than contractors are accustomed to credit with fair thinking.

In any event, let us be done with mere wailing over high wages. He who is acting along lines that have brought success to others may have some right to complain—but we are inclined to think that he is not the man who is complaining.

Higher Standards For Road Construction Will Mean Higher Prices

CHANGES in concrete-road construction practice which will alter contracting methods in some important particulars are forecast by the action, noted on page 955, of the conference of highway engineers of the leading road-building states of the Mississippi Valley. The recommendations of this conference, while they do not commit anyone to definite action, are the mature conclusions of the highway officials who participated, and in general it may be expected that they will dictate practice in the present season's construction and to a greater extent in the construction of coming seasons. Evidence in support of this belief is found in the new specifications of the Division of Highways of Illinois, which were reviewed in *Engineering News-Record* of Apr. 10, 1919, p. 735. In some particulars the requirements of the Illinois specifications are even more exacting than those recommended by the conference.

As was stated editorially by *Engineering News-Record* of Mar. 27, 1919, p. 599, opinion is becoming settled that the wet mixtures which have been used are no longer permissible for road construction. Concrete mixed so dry that it must be compacted by tamping, and a rigid control of consistency by slump tests in the field, will in a year or two be common requirements in specifications for concrete roads. A general tightening up of the control of subgrade construction, cold-weather work, and finishing and curing, will accompany the demands for richer and stiffer concrete mixtures. As a whole, construction standards will be raised.

Revision of contracting methods must naturally follow these revisions in construction practice. In accomplishing this revision the public-roads officials has a part to play as well as has the contractor. No obstacle stands in the contractor's way to meeting the new requirements except agreement on prices. *Construction will cost more.* Not merely are materials and equipment more expensive and wages much higher, but richer mixtures of tamped concrete cost more to place and finish. Public-roads officials must revise their standards of prices as they have revised their standards of quality and perfection of workmanship.

Even then there remains this question: Are the roads built on the new standards worth the added price? The engineers responsible for the new standards will say, Yes. Some experienced contractors, men ranking as engineers, have said, No. In theory the engineers have the better of the argument and should be supported. For the final answer, however, do we not need to wait the test of service?

Scientific and Technical Employees of Government Form Union

THE scientific and technical employees of the Government departments and agencies in Washington have taken steps to form a branch of the Federal Employees' Union No. 2, which is a part of the American Federation of Labor. This union has now about 21,000 members, and has been very active in connection with Congressional bills affecting employment in Government service in the District of Columbia. The formal vote to join this union was taken at a meeting May 8, at which 185 scientists and engineers favored the plan and 132 favored a permanent organization without affiliation with the American Federation. The leading speaker for the union plan was Dr. Edward B. Rosa, chief physicist of the Bureau of Standards, and actively interested in the American engineering standards movement, as recorded in the two preceding issues of *Engineering News-Record.*

The news that some of the men long prominent in Government scientific and technical work have organized a labor union and have become associated with the American Federation of Labor will startle those who have not followed the recent developments in collective bargaining and do not appreciate the particularly hard lot of the Government specialist. He has been driven by the hopeless condition in which the high cost of living leaves him to take decisive measures to present his plea for fair treatment to Congress. A characteristic incident is the assumption by Thomas H. MacDonald of the duties of the nation's roadbuilder, salary $6000, and the practically simultaneous resignation of H. K. Bishop from the Bureau of Public Roads to become chief engineer of the Indiana Highway Department, salary $7000. Congress asks Mr. MacDonald to make a financial sacrifice in order to accept the most responsible highway post in the country; the experienced business men on the Indiana Highway Commission offer Mr. Bishop the proper compensation for the work. In this difference of viewpoint lies the fundamental explanation of the decay that is beginning to take place in Government scientific and technical work. It is a matter of personnel, of the impossibility of doing good work continuously without reasonable compensation. The unionizing of the Government scientist and engineer is proceeding rapidly only because these classes like the work, appreciate the honorable position of Government service, and wish to stay in it if there is any way to bring to the attention of Congress in a convincing way their present unfortunate condition. If Congress does not heed the warning, the Government departments will suffer seriously.

This decision to have a union of the scientific and technical staff in the District of Columbia has another disturbing aspect. Salaries are paid to these men under two plans. Congress sometimes allots a lump some for a group of investigations, and the bureau chief and his superior, the cabinet officer at the head of the department, then fix the number and salaries of the men engaged in this work. This allows considerable flexibility in arranging the work and selecting men for it, and is the system under which all the activities of the Bureau of Mines are conducted. The second system is the designation by Congress of the grades of men to be employed, the compensation in each grade, and the number of men in each; this is known as the statutory-salary system, and all the work of the Patent Office is conducted under it. In most bureaus there are both statutory and lump-fund salaries, and, so far as scientific and technical work is concerned, the lump-fund system is much better. Congress desires the statutory system, however, on the ground that it enables that body to control the activities of the bureaus more effectively than under the lump-fund system. The difficulties it presents to a bureau chief can be understood by picturing the predicament of a chief engineer of a railroad who was told at the beginning of each year just how many grades of assistants from office boys to chief assistants his staff should contain, how much each man was to be paid and how many men in each grade he could have.

Through the efforts of the Federal Employees' Union No. 2, a joint Congressional committee has been appointed to study a readjustment of the salaries of practically all Government employees in the District of Columbia, in order that work requiring similar qualifications and involving like responsibilities may be uniformly compensated. The bureau chiefs responsible for carrying out the work efficiently and satisfactorily fear that the outcome will be the placing of all Government work on a statutory basis. If this is done, the difficulties of a bureau chief will be greatly multiplied, and the salaries of these chiefs should be substantially increased in most cases. It will then be practicable to increase the salaries of other bureau employees to the amounts that similar responsibilities command in private life. As a matter of fact, the most underpaid men in Government service are the bureau chiefs, and the next in the scale of inadequate compensation are the employees at the bottom of the scale of salaries. How some of the latter have managed to live during the war is a mystery to all but themselves. With them it was a question of mere existence, with bureau chiefs it was a question of duty to their families conflicting with duty to the country, and in the grades between the top and bottom the question was one in which both considerations entered in many cases. The public—at least the public which understands the conditions—will certainly sympathize with the attempt of the scientific and technical employees to secure adequate compensation, even though it may not hold that unionization is necessary to make Congress act justly.

Sweetwater Dam Enlarged for the Third Time

Latest Reconstruction Adds to Height, Provides Siphon Spillways and Enlarges Weir Spillways to Take Care of Maximum Flood—Second Time Dam Has Been Given More Spillway Capacity

By H. N. Savage
Consulting Engineer, Sweetwater Water Co., San Diego, Calif.

TWICE overtopped, each time with an unprecedented flood flow, and three times enlarged to provide either larger storage or larger spillway capacity, the Sweetwater dam, near San Diego, Calif., is a notable example of the revision of an engineering structure to meet new conditions not considered when it was built. The latest flood, in January, 1916, was about three times as great as any previously recorded, and required the reconstruction just being completed. While repairing the 1916 flood damage, there was a general remodeling of the structure which provides for passing a flow of 45,000 sec.ft. This included the construction of new siphon spillways and the enlargement of the previously built weir spillway.

DOWNSTREAM VIEW OF DAM WITH SIPHON SPILLWAY ON LEFT

The dam, seven miles from San Diego Bay and ten miles east of San Diego, Calif., was projected by the San Diego Land & Town Co. and put under construction in 1886. The purpose of the reservoir to be created was to impound the seasonal, and not infrequently torrential, run-off from the drainage basin of the Sweetwater River to insure an adequate and continuous supply of water for irrigation and domestic purposes for use in connection with a large area of land located adjacent to the bay and City of San Diego in the southeast, and which the company was developing for sale for suburban homes and for growing citrous fruits. Construction was commenced in accordance with designs developed by F. E. Brown, who had then only recently designed and constructed the famous Bear Valley dam.

The supervision of the engineering and construction work on the Sweetwater dam was subsequently, and before any material construction progress had been made, turned over to the late James D. Schuyler, who redesigned and supervised the construction of the dam, which was completed in 1888.

The structure, which was of uncoursed rubble masonry, was 90 ft. high above lowest foundation; 333 ft. long, exclusive of spillway bays; 46 ft. thick at base and 12 ft. thick at top; of the arch type, with a radius of 213.3 ft. It created a reservoir with a maximum storage depth of 70 ft., having a maximum length of about four miles and a width of one mile; impounding capacity, 6,000,000,000 gal. of water, equal to about 18,000 acre-feet.

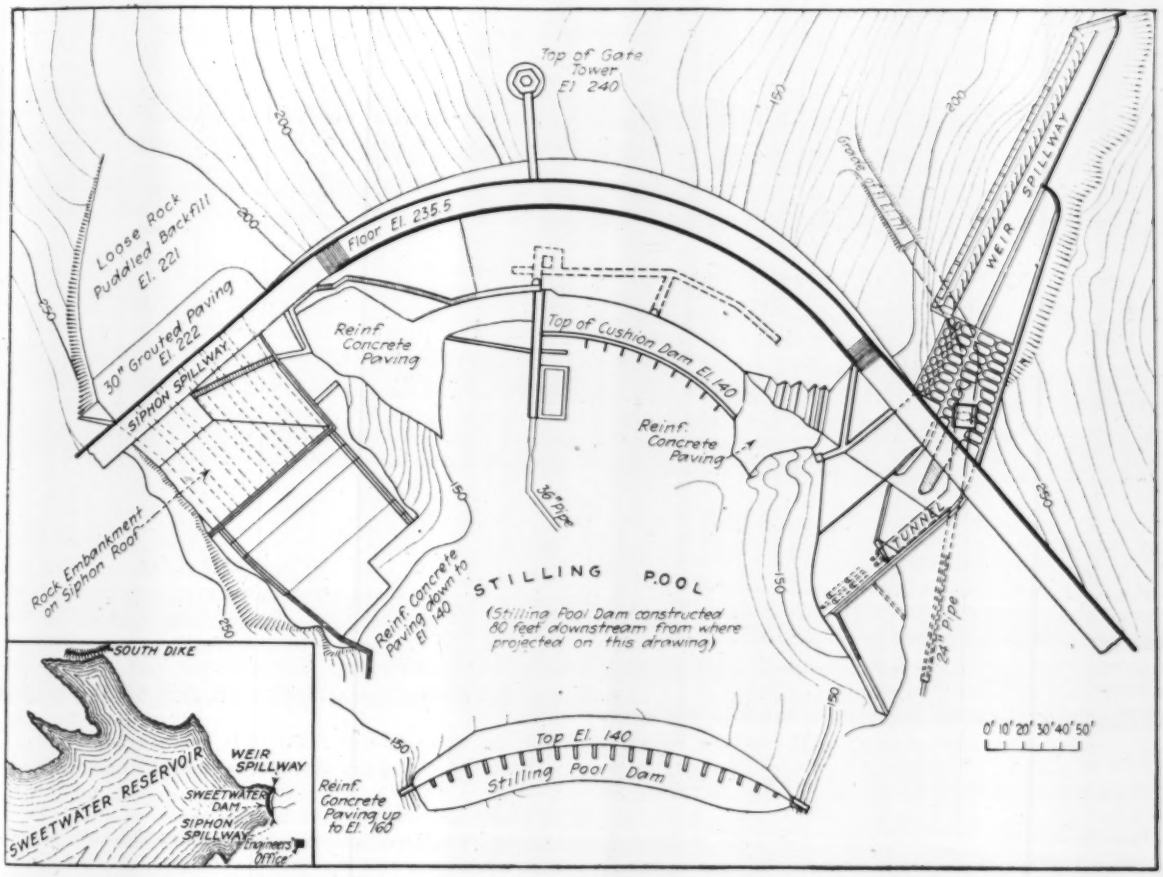
The Sweetwater River has its source in the Cuyamaca Mountains of the Coast Range. The maximum elevation drained is 6515 ft. The river flows southwesterly and discharges into San Diego Bay. The drainage basin has a length of 40 miles and an unusually uni-

form width averaging about 4½ miles. The total area of the basin above the dam is 186 square miles.

The mean annual rainfall at San Diego, as observed for the past 66 years, has been slightly less than 10 in., and has varied from a minimum of about 5 in. to a maximum of 16.03 in., except for the years 1883-84, when it was 27.59 in. The mean monthly rainfall for the 66-year period has been for July, 0.06; August, 0.10; September, 0.08; October, 0.36; November, 0.96; December, 1.79; January, 1.84; February, 1.98; March, 1.48; April, 0.62; May, 0.32; June, 0.06.

The months having greatest precipitation have been December, 1873, 5.46 in.; March, 1893, 5.50 in.; December, 1879, 6.30 in.; January, 1895, 7.33 in.; January, 1916, 7.56 in.; February, 1884, 9.05 in. Excessive rainfall (2.50 in. in 24 hours) has occurred but three times during the period. The rainfall for the 24 hours of Jan. 19, 1895, was 2.15 in., and for the 24 hours of Jan. 26-27, 1916, was 2.41 in. The rainfall on the Sweetwater drainage basin normally increases with the elevation, closely approximating 0.6 in. for each 100 ft. increase in elevation. Southwesterly winds approaching hurricane velocity usually accompany maximum rainstorms. Winds with maximum velocities have occurred as follows: March, 1912, 43 miles per hour; February, 1914, 45 miles per hour; January, 1916, 54 miles per hour.

Neither observations nor gagings had been recorded of the discharge of the Sweetwater River previous to 1886. When the dam was constructed in 1886-8 a discharge capacity of 1800 cu.ft. per sec. was given the spillways. Some additional capacity was provided by the blowoff pipes; this, together with the storage afforded by the reservoir, was then deemed by the engineer sufficient to handle any flood which might occur. In March, 1893, the rainfall was 5.50 in., and the flood into the reservoir reached the extreme volume of 5500 cu.ft. per second. The spillway capacity was thereupon substantially increased. In the month of January, 1895, the rainfall was 7.33 in., causing a flood which developed a peak discharge of 18,148 cu.ft. per second, which continued for over one hour. The Sweetwater dam was overtopped to a maximum depth of 22 in., notwithstanding all the spillways and blowoffs had been opened well in advance. The water poured over the top of the dam for 40 hours before the spillways and the blowoffs sufficiently reduced the volume to bring the storage down to the level of the parapet, the mean flow for the 24 hours, including the peak, having been 7200 cu.ft. per second.



PLAN AND LOCATION DIAGRAM OF SWEETWATER DAM NEAR SAN DIEGO, CALIF.

Upon the writer, then acting as chief engineer, devolved the responsibility of making the repairs which had been necessitated by the flood of 1895, and extensions to the Sweetwater reservoir structures to handle safely and pass a flood of equal volume or of somewhat greater volume, if one such should occur. The late James D. Schuyler, at the writer's request, collaborated in formulating the designs for the repair and extension

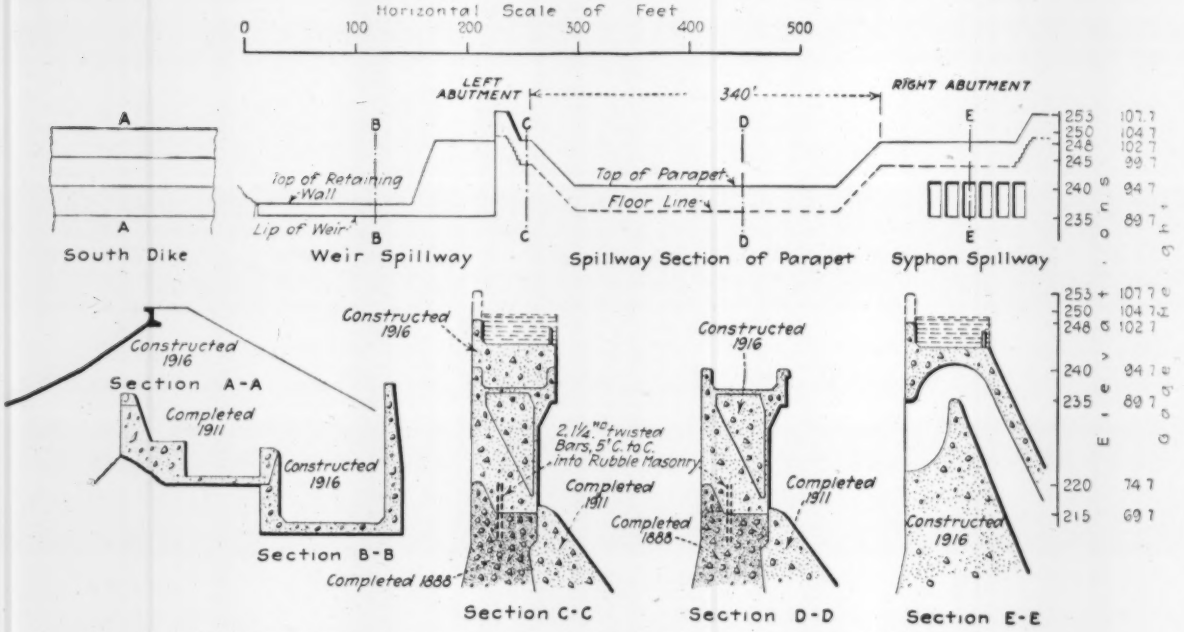
work. The discharge capacity of the spillways was materially increased by adding four bays to the original seven and by doubling the effective depth of all the bays. A flood-discharge tunnel, which had previously, in 1889, been driven from about the midway elevation of the reservoir around the left abutment of the dam, was put under control to discharge through four blowoff pipes—two 36 in. and two 30 in. in diameter—each fitted with tandem operating and emergency gates.

Provision was also made for the central 200 ft. of the dam to be safely overtopped in emergencies, by increasing the height of the parapet wall at either end of the dam to prevent its being flanked by passing floods, and by constructing a 15-ft.-high masonry structure across the cañon 50 ft. downstream to form a water-cushion basin to prevent the Sweetwater dam, if overtopped, from being undermined.

Opportunity was also accepted to increase the reservoir storage 25% by adding 5 ft. to the effective height of the dam, thereby bringing the normal reservoir height up to gage 75 ft., or El. 220 ft., based on sea level.

The Sweetwater Water Co. early in 1910 decided to increase further the storage capacity of the reservoir by 70%. The writer was prevented from responding to the water company's call by reason of other exacting duties, and the late James D. Schuyler was selected for the responsible task of preparing the plans for the extension. This work was described by Mr. Schuyler in *Engineering News* of Mar. 30, 1911, p. 369. He raised the effective height of the dam 15 ft., thus bringing the normal reservoir surface up to gage 90 ft., or El. 235 ft., based on sea level. Previous to the extension of the dam in 1910-11 the stability of the structure had been dependent on its arch plan. The resultant of pressures, with a reservoir full and the dam overtopped, fell well outside of the toe and some distance downstream therefrom. The dam, as extended, was thickened at the base by 30 ft. and transformed into one of the usual gravity type in that the resultant of pressures with a full reservoir fell inside the middle third. It had a factor of 2 against overturning. An additional factor of safety of very considerable but indeterminate amount was retained by the arch plan of the structure. As completed in 1911, the height of the dam above the lowest foundation was 108 ft. to the fixed lip of the spillway at El. 233 ft. above sea level. The spillway was provided with stop planks at El. 235 ft., corresponding to reservoir gage 90 ft., at which elevation the reservoir had a storage capacity of 35,051 acre-feet on an area of 1055 acres.

The spillway was located along the reservoir at the left end of the dam, with which it was monolithic, and consisted of a concrete-lined channel controlled by a



PROFILE SHOWING DIFFERENT RECONSTRUCTIONS OF SWEETWATER DAM

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The spillway, together with the blowoff pipes through the tunnel and the storage in the upper portion of the reservoir, was deemed by the engineer sufficient in capacity to control and pass a flood similar to that of 1895, which was the greatest previously recorded.

An earth embankment, known as the south dike, 650 ft. long, with its crest corresponding to reservoir gage 97.7, at El. 243, and having a height of 23 ft., had been constructed across a saddle in the rim of the reservoir basin one mile south of the dam.

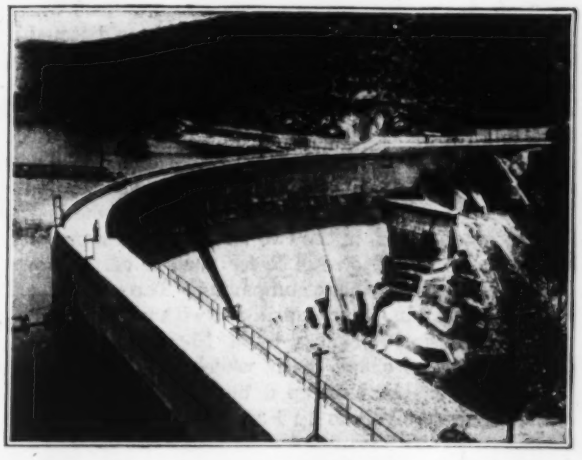
Beginning Jan. 14, 1916, there was an extraordinary storm period in the vicinity of the dam. The storm was in two sections, the first, occurring between Jan. 14 and Jan. 20, giving a precipitation of 5.11 in., and the second, between Jan. 25 and Jan. 28, giving a precipitation of 3.09 in. at the dam, with much greater precipitation on the higher slopes of the watershed to the east, which at a distance of only 10 miles back up into the drainage basin from the Sweetwater reservoir. The precipitation amounted to 10 in. in the 24 hours of Jan. 27, of which 7 in. fell in 14 consecutive hours, thus

largely accounting for the unprecedented flood discharge which followed.

The first section of the storm filled the reservoir to gage 92.9 ft. and to within 22 in. of the top of the parapet, and the second section came upon the top of the full reservoir. This storm raised the reservoir to gage 98.34 ft., corresponding to El. 243.64, overtopping the parapet of the dam 3.66 ft. and overtopping and destroying the south dike.

No apparent damage was done to the masonry section of the Sweetwater dam by the flow of 3.66 ft. in depth over its parapet. At the north end of the dam, as extended, there was a section 90 ft. long with a maximum height of 20 ft., composed of an earth-and-rock embankment with a concrete core wall and parapet. This embankment was washed out and a channel 90 ft. wide was eroded around the north end of the dam to a depth of about 45 ft. below the top of the parapet, or to El. 195. At the south end of the dam the rock against which the dam abutted was also cut away by the water to a width of 20 ft. and a depth of 40 ft. Views of the damage appeared in *Engineering Record* of Feb. 12, 1916, p. 225.

In both cases this erosion is explained by the nature of the rock upon which the dam is founded. This is a porphyritic rock intersected by innumerable cleavage planes by which the rock is divided into blocks held together by some cementing material easily softened by water and slowly disintegrated by air. The rock is a suitable and reliable material for foundations so long as it is protected from running water.



LOOKING ACROSS DAM TOWARD WEIR SPILLWAY

The flood of Jan. 27, 1916, produced an estimated maximum peak discharge of 45,500 cu.ft. per second for a period of over an hour, and an average discharge of over 20,000 cu.ft. per second for a 24-hour period including the peak. As a basis for developing plans for spillways it was deemed advisable to provide a total capacity sufficient to handle a discharge one and one-half times that produced by the flood of Jan. 27, 1916.

All computations to determine the spillway discharge required are based upon the reservoir being filled at the beginning of a flood to normal capacity, gage 90 ft., El. 235.

A flood of similar characteristics to that of Jan. 27, 1916, but having a peak discharge of 50,000 cu.ft. per second, as modified by the temporary impounding capacity on the normal reservoir above the crest of the weir spillway, at gage 90, El. 235, would be controlled and safely passed by the spillways as provided, and only require their operation up to a maximum discharge of 32,000 cu.ft. per second, and the maximum water in the reservoir would not exceed gage 98, El. 243.

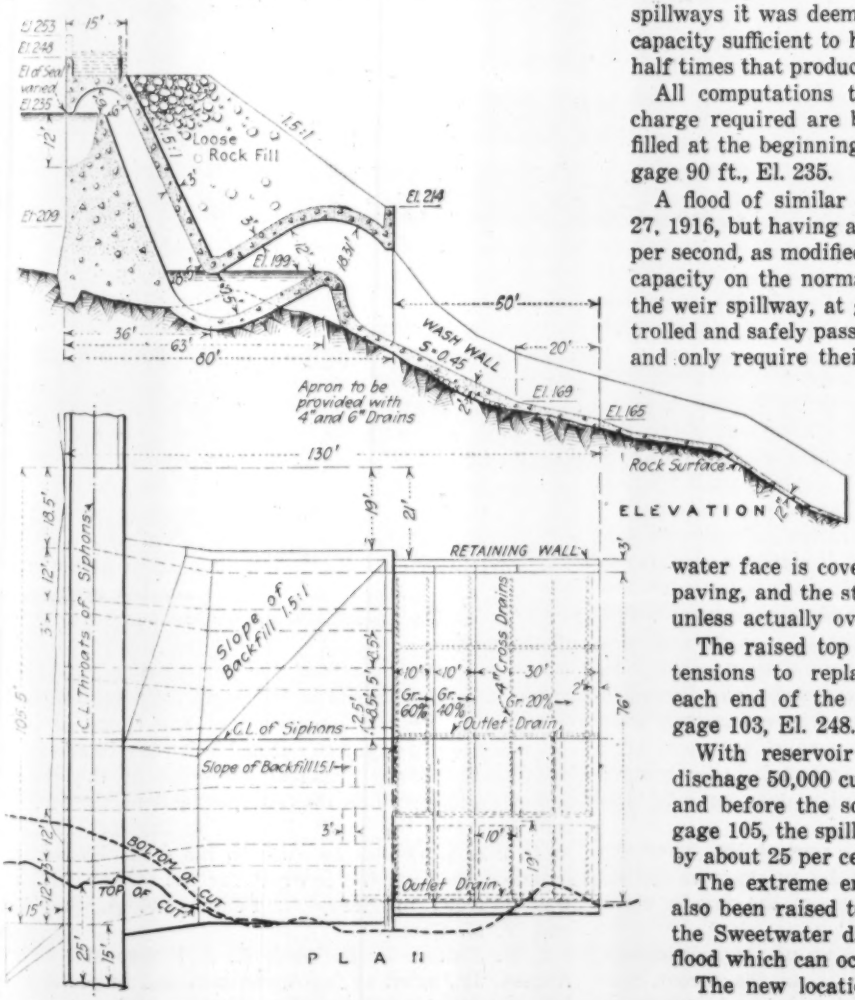
In the design for the south dike the top was fixed at gage 105, El. 250. The water face is covered with a reinforced-concrete paving, and the structure should not be damaged unless actually overtopped.

The raised top of the parapet wall of the extensions to replace the eroded abutments at each end of the Sweetwater dam was fixed at gage 103, El. 248.

With reservoir gage 103, the spillways will dischage 50,000 cu.ft. per second continuous flow, and before the south dike could be overtopped, gage 105, the spillways' discharge would increase by about 25 per cent.

The extreme ends of the parapet walls have also been raised to gage 108, El. 253, to prevent the Sweetwater dam from being flanked by any flood which can occur.

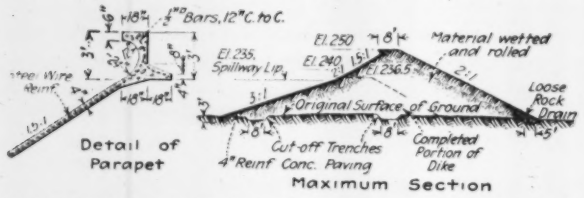
The new location of the south dike is somewhat within the reservoir basin from its former



DETAILS OF SIPHON SPILLWAY ON SWEETWATER DAM

location, due to the erosion by the escaping flood waters at the original site. The new alignment was dictated by the local topography. The south dike is 1260 ft. long and 37 ft. high from the bottom of the front-face concrete cutoff wall. The foundation and the materials available for construction both indicated that the structure should be an earth embankment. The material used was about half clayey adobe and half gravelly, ranging from fine to small boulders. The latter, when sized larger than 3 x 4 in. in the two largest dimensions, were rejected and placed on the lower portion of the downstream slope for drainage and paving. The embankment was placed in 6-in. layers, sprinkled with water and compacted to 4½-in. thickness by a 10-ton roller having corrugated faces on all of its wheels. The water face is sloped from the base up 3 horizontal to 1 vertical, changing successively to 2 : 1 and to 1½ : at the top portion.

The water face is protected from wave erosion by a concrete paving 4½ in. thick, reinforced with steel wire mesh No. 8 B.w.g., spaced 4 in. c. to. At the top the paving merges into a steel reinforced-concrete parapet curved to deflect waves back onto the surface of the reservoir and prevent them breaking over the top of the dike. A coat of crude oil containing 30% asphaltum was applied to the downstream slope and top



ENLARGEMENT OF SOUTH DIKE ON SWEETWATER DAM

of the dike, at the average rate of 5.6 gal. per square yard of surface, to prevent the growth of vegetation, the burrowing of animals, and erosion by rainstorms.

The topography and the geological formation of the reservoir basin restricted the location of all spillways to the immediate vicinity of the Sweetwater dam.

The necessity of replacing both abutments of the dam, which had been eroded away by the flood, made it advisable for economical reasons to combine the spillways with the gravity extension at either end of the dam. The topography of the gaps dictated materially the type of both end spillways.

In making studies and comparative estimates preliminary to deciding on the final designs, it was found advantageous to divide the total spillway capacity required about equally among the three structures which it was found most advantageous to provide and construct. The capacity of the original weir spillway at the left end of the dam was very materially increased by means of a connected channel, with a relatively wide and deep cross-section, located parallel with and back of the original channel. Three ports left in the gravity extension from the left end of the dam serve as dischargeways for the left spillway.

Provision for overtopping the central 236 ft. of the dam in emergencies was made by raising the top of the gravity extension at both ends of the dam by eight feet.

A siphon-type spillway, made up of six independent rectangular tubes each 12 x 6 ft. at the throat, was decided on for the right end of the dam. An efficiency factor of 70% was used in computing its discharge capacity. The type was selected for several reasons; prominent among them were the automatic action approaching maximum capacity whenever water rises above the normal flow line, such as a flood discharge into a reservoir already filled.

In this instance the siphon-type structure provided a necessary support for the perpendicular abutment rock below the dam, and on account of the height of the lip permitted the placing and maintenance of a rock embankment to protect the vertical face of the rock abutment above and adjacent to the end of the dam. The roof of the siphon-spillway feature also furnished a foundation for a rock embankment to protect the vertical face of the rock abutment below the dam to prevent its ravelling. The rock embankments at the north end of the dam were made of rock excavated from the additional left weir spillway channel, which was trammed across the top of the dam. The rock wasted on top of the siphon-spillway roof, weighing about 6000 tons, is also a very desirable additional factor in resisting the tendency of the water discharging through the siphon tubes to set up vibration in the structure.

During maximum flood discharge there will be a potential horsepower of about 175,000 in the water discharging through the siphon, of which about one-half may be destroyed in entering, passing through and discharging from the structure.

In order to protect the rock abutments and foundations in the vicinity of the base of the dam from further erosion, which might be disastrous, a stilling pool dam has been constructed across the cañon 300 ft. below the base of the Sweetwater dam. It is of the hollow buttressed type, 15 ft. high, 200 ft. long, with its upstream face sloping with an angle of 45° with the horizontal.

The relatively high-up abutment rock, down against which water from over the top emergency spillway will impinge, has been protected with concrete paving averaging 1 ft. thick, reinforced with wire mesh spaced 4 in. c. to c., hung on iron pins spaced about 5 ft. c. to c., holes for the pins having first been drilled into the face of the sloping rock cliffs.

The emergency repair work on both the Sweetwater dam and the south dike was rushed forward under Superintendent W. M. Gates, in charge of temporary construction, Don Moore in charge of team work. Repair of main pipe lines was carried on under miscellaneous foremen with forces obtained from the Western Pipe and Steel Co. R. H. Willcomb acted as resident engineer and made all the designs for the permanent work under the immediate and continuous supervision of the writer.

An emergency contract for the placing of 10,000 cu.yd. of earth material in the south dike was awarded to Henry G. Fenton, contractor, of San Diego, and an advertisement was gotten out and bids were received for building the three principal schedules of the repair and extension work on the Sweetwater dam, the stilling pool dam and the south dike. The contract for the south dike work was awarded to the C. L. Hyde Construction Co., and the contract for the other schedules was awarded to Henry G. Fenton, W. A. Stebbins and W. M. Gates.

C. F. Fulton, B. B. Boyd, E. I. Fisher and E. P. Watson, Jr., acted as instrumentmen and inspectors at different times on the work.

What the American Army Engineers Did in the War

The following tribute to the fighting and working engineers of the United States Army is a part of an official report on the war made by Benedict Crowell, assistant secretary of war and director of munitions. The entire report will tell in detail the extent of America's participation in the mechanics of the war. These extracts are printed here to give wider circulation to this official recognition of the American engineers' work in the 17 months of war.—EDITOR.

IN DESCRIBING the activities of the engineers, we are carried to the front itself, into the zone beaten by enemy fire, where machine-gun bullet, bursting shell, and deadly gases have brought sudden death and painful wounds to many members of the technical services. A large proportion of the engineers are combatant troops, constituting in the American Expeditionary Forces about 8% of the total combatant troops engaged. These troops, trained and equipped to march and fight as infantry, demonstrated their fighting qualities during the war on numerous occasions, both when used as infantry to increase the rifle strength of that arm and when fighting as engineers to obtain possession of terrain as a preliminary to the exercise of their technical art in its organization.

From the day the first sector was taken over by American troops in November, 1917, until the Meuse River was passed and the enemy, in flight, sought an armistice to save his armies from destruction, the combatant engineers—the "sappeurs" of French soldier lore and song—fought and bled in a manner never to be forgotten. Railroad engineers, nominally considered noncombatant, fought with a will at Cambrai, dropping their tools to take arms and fight stubbornly shoulder to shoulder with their British brothers with whom they were learning to work under the peculiar conditions of the front. From Cantigny to Chateau Thierry, engineer troops fought as well as worked, and often not only advanced with the infantry under or through the barrage but actually led the first wave, to demolish or remove the obstacles placed in its path. Through the days, when from March 21, 1918, until July 18, 1918, the German army made its rapid plunges toward Paris until checked and thrown back at the Marne near Chateau Thierry, the sapper troops fought and worked with the infantry of their divisions, enduring the same dangers, privations and hardships, and winning equal honors and commendation.

THEY FOUGHT AS WELL AS WORKED

In the drive at St. Mihiel and through the Argonne, the combatant engineers played a conspicuous part. Advancing with the tanks, they made possible the passage of many difficult points for these lumbering monsters, against which was directed a particularly destructive fire. Using elongated torpedoes of high explosive, they prepared passages for the infantry through the broad, barbed-wire entanglements, echeloned in depth by numerous separate lines, each to be breached and passed before the objective could be gained. In this work the engineers fought as well as worked, reducing the machine-gun nests that hindered their operation, cleaning up the strong points that delayed the advance of the tanks they were assisting, and throwing extemporized foot-bridges across the streams which barred the further advance of the infantry.

Actually fighting, taking prisoners, reducing machine-gun positions and combat groups, the combatant engineers did their part in the winning of the reconquered ground, as well as the lion's share of its organization for the defense and the maintenance of the communications behind it. In this last respect alone, the engineers, as combatant troops, opened across No Man's land the first communications practicable for the light artillery, which pressed forward immediately behind the infantry troops to their support and protection.

Filling in trenches, removing wire entanglements, building trestles across wide mine craters, searching for and rendering inoperative treacherous mines and traps of extreme ingenuity and destructiveness, the sapper found a wide field of operations for the exercise of his functions.

Shattered and obliterated by four years of shelling and mining, trenching, and countermining, the "roads" across No Man's Land existed only on the map, and as they retreated the Germans demolished and obstructed the highways behind the old front from which they had been driven, with the thoroughness and attention to detail for which they are noted.

ROAD BUILDING UNDER ENEMY FIRE

As our infantry advanced, upon their heels, literally speaking, came our engineers, to attack the problem of providing for the artillery and the supply trains a means of following. From the standpoint of the road builder in civil life, their methods were crude in the extreme, but for the military purpose and the pressing immediate needs, their road-building achievement was adequate. The engineers sometimes reopened abandoned quarries, and sometimes started them where none had existed before, to obtain a supply of road material, which was supplemented and in some cases replaced by the use of débris from ruined villages and shattered farmhouses. From demolished structures many useful materials were extracted and adapted to the military purpose by the engineers. Where bridge and trestle timbers were lacking, deserted buildings—in one case the tower of a ruined church— filled the need. Where shell hole or crater yawned a remnant of a stable wall might be pulled down by ropes and man-power, and broken up to fill the void.

Through the dense woods, the soft forest floor offered no support even to the light artillery, and miles of corduroy and brush path were built to permit the guns to advance to the reinforcement of the attack. In many places the tactical situation admitted of insufficient time to build even the crudest paths, and then the engineers fell to and assisted the artillery and the supply wagons to get through and over the bad spots, replacing guns on the road where they had run into the ditch, righting and reloading combat wagons when they had turned over in shell holes or deep ruts.

While thus engaged the sapper troops were subjected to the fire of the enemy artillery seeking to prevent the advance of the supporting guns, and, further, they were working within the zone of combat enemy aviators, the rattle of whose deadly machine guns, as they plunged at low altitude toward a busy working party, was as much to be dreaded as the high-explosive bombs which they dropped.

Behind the combatant engineer troops, extending through the service of supply to the base ports and across the ocean to the United States, was an organization of technical noncombatant supply and administration. The work of these production, construction, and supply departments in France was organized under the administration of three divisions of the office of the Chief Engineer. These were the division of military engineering and engineering supplies, the division of construction and forestry, and the division of light railways and roads.

The division of military engineering and engineering supplies was charged with the procurement, standardization, and distribution of all classes of supplies used by engineer troops and with the current investigations into new developments of the art of military engineering. The division of construction and forestry was charged with all construction work in the service of supply, and also with the procuring of forest products for the American Expeditionary Forces. At the signing of the armistice its organization totaled 150,823 men, of whom about 127,000 were constantly engaged in production work. The light-railway and road regiments of engineers attached to the armies at the front, while their duties did not carry them so far or so much into the zone of enemy fire, may be considered as combatant units, since they operated with and in support of combatant troops in the field. To the light-railway regiments were assigned the construction, operation, and maintenance of the light railroads of 60-cm. gage, a great quantity of which was used during the war.

Engineering Profession Responded Nobly

To furnish the necessary organization of technical troops and specialists the original engineer arm of the United States Army was increased to 131.5 times its pre-war strength, and the proportion of engineer troops relative to the total forces was increased from 1.6% to 10.8%. To accomplish this, a heavy demand was made upon the technical professions and upon the industries of this country. In filling this demand most necessary assistance was given by the engineer societies and the engineering journals, whose patriotic work demands the highest praise.

In situations requiring special knowledge, almost always there could be found some specialist capable of adapting himself and his work to the military needs. Engineer officers for the combatant regiments were younger members of the technical professions, who were sent to the training camps provided for the purpose and there given the essentials of strictly military knowledge. This training was later supplemented by courses in engineer and line schools located in France. The training officers of the regiments were supplied from the Corps of Engineers, these men having both the military and technical knowledge fitting them for the command. The diversity of education and experience necessary in all branches of the engineer service may be understood by a consideration of the duties of the different units sent to France during the war—specialist units, in addition to the strictly combatant divisional regiments, who also numbered among their commissioned and enlisted personnel many technical specialists, men of high attainment.

We had, for instance, seven railway-construction regiments, two railway-construction battalions, one regiment and five battalions for railway maintenance-of-way, two battalions for maintenance of railway equipment, four regiments and one battalion to operate our main military railways in France, three regiments to operate the light railways in France and their repair shops, two regiments for operating the regular railway shops, two regiments and six battalions for constructing buildings and other general construction work, two regiments for storing and transporting engineer supplies, a forestry regiment, a light-railway construction regiment, a regiment for building roads, a water-supply regiment, a mining regiment, a quarrying regiment, a technical regiment for handling surveying, sound ranging, and location of enemy positions by means of special apparatus, three survey and printing battalions, two railway-transportation battalions, an electrical and mechanical regiment, several companies to operate cranes, a camouflage service, five inland-waterway companies, five ponton trains, a ponton park, a railway-transportation and stores battalion, and also a searchlight regiment.

Upward Pressure Test Pipes Constructed in Concrete Dam

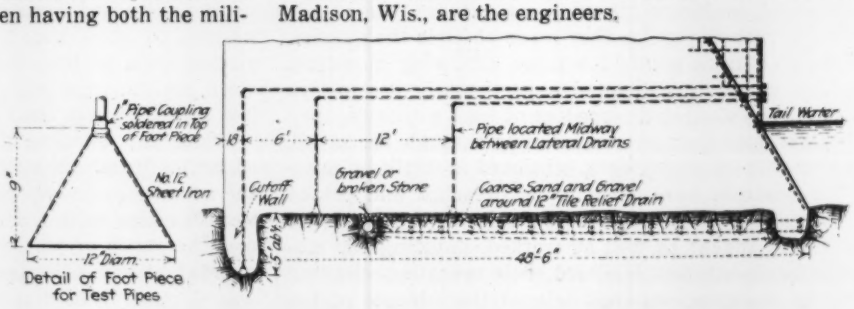
UPWARD-pressure test pipes were constructed in the base of the new Brule River dam in Wisconsin. This dam is constructed of concrete, and is about 70 ft. high, 6 ft. wide on top, and 48½ ft. wide at the base, and will sustain an average working head of 60 ft.

Provision is made for underdrainage by the use of a 12-in. vitrified tile drain, placed longitudinally with the dam, as indicated by the drawing and connecting with 12-in. lateral drains at right angles spaced every 20 inches.

To determine the effect of upward pressure, if any exists under the dam, 1-in. iron pipes were placed as shown on the drawing. Construction was simple, the only special detail being the inverted cone collector resting on the rock bed. Great care was taken to see that no concrete got under the cone.

It is believed that after construction is completed and the water is raised to full head these pipes will afford observations on upward pressure which may be of value.

The dam was built for the Peninsular Power Co., of Wisconsin. Daniel W. Mead and Charles V. Seastone, Madison, Wis., are the engineers.



PIPES CONSTRUCTED IN DAM TO TEST UPWARD PRESSURE

Concrete Highway Construction Standards Raised

Mississippi Valley State Road Officials Recommend Tamped Concrete and Heavier Sections—Action Affects Wide Territory

BETTER built subgrade, heavier slab sections, graded aggregates, slump consistency tests, tamped concrete, and more intensive finishing are recommended for concrete roads by the Mississippi Valley Association of State Highway Departments. The exponents of this advanced doctrine are, moreover, putting its precepts into practice. A notable example is the Division of Highways of Illinois, whose new specifications were reviewed in *Engineering News-Record* of Apr. 10, 1919, p. 735, and May 8, 1919, p. 905. Other state highway officials announce that their practice will be similarly modified as conditions make action practicable.

The decision to revise standards of construction was reached at a two days' conference of the association members held in Chicago in February. With the highway departments of eight states represented, the standards of practice of the American Concrete Institute (See "Proceedings," Vol. XIV, p. 517) were considered, section by section, changed and extended as the delegates decided, and the original document as altered was adopted as recommended practice. The changes extended to minor details, but only those of broad significance to the contractor call for particular mention. They include pavement design, but relate for the most part to materials and methods of construction. Quoted matter contained in this article shows the alterations as adopted.

Heavier Slabs and Better Concrete

Concrete roads less than 18 ft. wide are inadvisable, but if single-track roads must be built a width of 9 ft. is recommended and no road widths between 10 ft. and 16 ft. are approved. The width of traveled grade is set at 24 ft. for all roads, and 8-ft. shoulders are advised for all widths of slab. A slab uniformly not less than 7 in. thick is specified for single-track roads, and for two-track roads up to 20 ft. wide the minimum thickness is 7 in. at the edges and 8 in. at the center. These thicknesses are roughly 1 in. greater than those set by the standards of the American Concrete Institute.

A 1:2:4 concrete is suitable when the slab is finished by machine; for hand-finishing the proportions are 1:2:3½. Consistency is to be governed by slump tests. "For this test 6 x 12-in. cylinders should be tamped full of the concrete as mixed and the cylinder immediately removed. For work that is to be finished by hand, the slump of the concrete upon removal of the cylinder should not exceed 6 in., and for work that is to be machine-finished, the slump should not exceed two inches."

Emphasis is put on the field testing of aggregates. Sieve grading, using Nos. 100, 48, 28, 14 and 4 screens, is specified. Volumetric tests for silt are approved for field determination, but unless this test shows less than 7% of silt materials are not to be accepted for construction until the quantity of silt is determined by the weight method. Fine aggregate must all pass a No. 4 screen, but natural sand or any mixture up to equal parts of sand and screenings is acceptable, provided the screenings are from durable stone and are without dust. For coarse aggregate, besides pebbles and broken stone, "slag of suitable quality and uniformity" is acceptable.

Stress is laid on subgrade construction. It is recommended that the subgrade be not trenched out, and that it be kept higher than the natural berms, so as to provide drainage directly to the side ditches. A 10-ton macadam-type roller is recommended and very careful rolling is urged. "If the rolling at any time causes the subgrade to become wavy, the rolling should be stopped immediately over the wavy parts, and the soft material investigated. In clays, this is almost always due to moisture and, unless it is possible for it to dry out by the sun and wind without delaying the work, it should be removed and replaced with dry clay or other suitable material that can be rolled in a satisfactory manner. If any depressions develop they should be filled with acceptable material as the rolling progresses."

It is recommended that the rough grading be completed very close to the intended cross-section of the subgrade and to the full width of the shoulders. The finished subgrade immediately ahead of the concrete should be corrected to proper cross-section, using a templet.

Where the aggregates are stored on the subgrade the latter should be completed fully in sections not exceeding 600 ft. in length, immediately before the aggregates are deposited. The surface should be brought to true cross-section, using a templet or other acceptable method, and the roller should be kept in constant operation while the aggregate is being delivered. Wherever possible, hauling over the finished subgrade with teams or motor trucks should be avoided.

Concreting Practice Made More Definite

Two-bag batch mixers are recommended for concrete-road work. The mixer should be equipped with "a boom and bucket or some other mechanical device that will deliver concrete of a proper consistency; also with an automatic timing device and a device that will accurately measure the water for each batch." The attention of mixer manufacturers "is directed to the advantages of perfecting a mixer that will shorten the time necessary for proper mixing and permit the inspection of the batch before delivery."

Duplicate pumping machinery should be provided, with booster pumps on long pipe lines. Steel side forms should be used.

The concrete may be transported from the mixer to place on the subgrade in any manner which avoids the segregation of materials. Every effort should be made to arrange for closing concrete-road work in the autumn on or about such date "as the Weather Bureau reports for the locality for the past 10 years indicate the probability of temperatures materially below the freezing point." If circumstances necessitate continuing work for a short period after freezing weather is likely to occur, precautions should be observed which will insure positively that the concrete may not become frozen under the most extreme conditions of temperature for the period, "as indicated by weather reports for the past 10 years." Concrete should be absolutely protected from freezing by suitable means for at least seven days after placing.

When mixtures of relatively dry consistency are used, "mechanical strikers and tampers should be used." Machines should be so constructed and operated that they strike off and thoroughly tamp the concrete, and that they "may be readily operated over the same area repeatedly." If a mechanical finisher is not used after

the spreading, the concrete should be thoroughly hand-tamped by means of a tamper "of the nature of a strike-board operated by one or two men stationed at each end of the tamper on opposite sides of the roadway." Hand-tamping should be vigorous and sufficient to consolidate the concrete in such a manner as to leave the surface behind the final strikeboard "true to grade, crown and surface, and absolutely free from porous places."

Trained Inspectors Essential

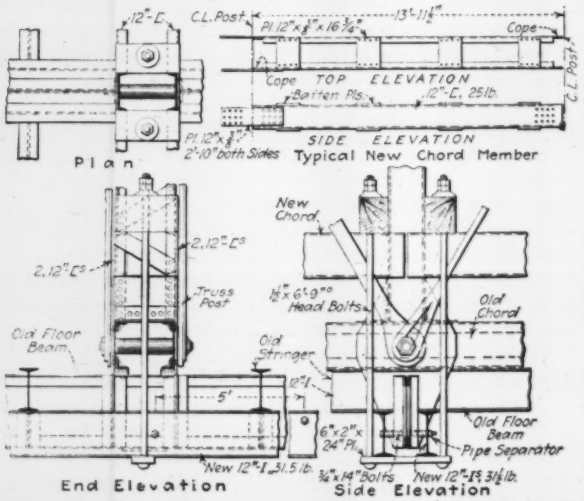
Inspectors should be selected with great care. The remuneration of an inspector should be sufficient to secure a man of the following qualifications: "Practical experience, knowledge of specifications and construction, absolute integrity, quick decision, sound judgment, forceful personality, common sense and the ability to command the respect of the contractor." The inspector should have broad perspective and should be able to distinguish between essentials and nonessentials. It is recommended that inspectors of concrete construction receive a preliminary course of training in their duties, including a study of materials and the interpretation and significance of laboratory and field tests.

Put New Chords on Drawbridge Carrying Traffic

Engineer Plans Work to Avoid Closing of Busy Street — Bridge Swings Free of End Supports While Riveting Is Done

THE reinforcement of an old swing bridge without the use of falsework and without putting the bridge out of service was a difficult piece of work accomplished successfully at Chicago. The particular methods employed were adopted in order to avoid serious interruption to travel on a heavy-traffic street.

The repair work was of an unusual character, consisting in the application of new bottom chords and floor-beams to the Clark St. bridge over the Chicago River. The work was imperative on account of corrosion and general deterioration, coupled with the necessity of retaining the old structure until funds are available for its renewal. It will be part of the program of reconstruction of all the old river bridges at Chicago. The swing span, built in 1889, is 208½ ft. long, with three through trusses spaced 21 ft. on centers.



TYPICAL NEW CHORD MEMBER AND ARRANGEMENT OF NEW I-BEAMS SUPPORTING STRINGERS

New bottom chords for the reinforcement of the trusses were located above the floor, for convenience of erection. They were composed of pairs of 12-in. channels placed with the flanges inward and connected by batten plates at top and bottom, the flanges being cut away at the ends to allow the webs to be riveted against the truss posts. Splice plates were placed outside of the chord joints on these posts.

While the riveting was being done the bridge swung free, being supported entirely at the center and being clear of end supports. Thus there was no upward reaction in the trusses, and although the bridge tipped as cars ran on and off there was no difficulty in fitting the new chord members.

Deterioration of the floor-beams and their connections made it necessary to provide additional supports for the stringers, which were in good condition. At each panel point two wood blocks were placed across the new chord and against the post, forming supports for the threaded ends of two hanger rods whose upset heads carried a bearing plate. Upon each pair of plates were placed the ends of two 12-in. I-beams, one on each side of the old plate-girder floor-beam, and these were drawn up against the stringers by means of nuts on the hangers. The I-beams were secured in place by through bolts spaced about 5 ft. apart and located alternately at the center line and top of the webs. These bolts passed through pipe separators fitted between the webs of the I-beams and old girders.

This method of reinforcement was planned by F. H. Avery, engineer of bridge construction and repairs, Department of Public Works, under the direction of John Ericson, city engineer, and Thomas G. Pihlfeldt, engineer of bridges. The work was done by city forces under Mr. Avery's supervision.

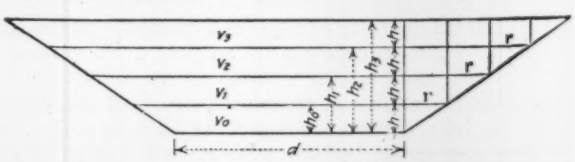
Laying Out a Reservoir Gage Table

By E. D. Cole
Chief Engineer, Empire Gas & Fuel Company, Bartlesville, Okla.

IN COMPUTING a gage table for a circular reservoir with sloping side walls, it is customary to figure the volumes for each inch of height, measured from the gage plate on the bottom. The necessary computations in this case are somewhat long and tedious, owing to the reservoir being considered as the frustum of a cone with volumes increasing with the height above the gage plate by a constantly increasing increment.

The writer recently had occasion to figure such a gage table for a 350,000-bbl. oil-storage reservoir of this type, and devised the following formulas, showing the relation between succeeding volumes corresponding to equal values of height. By this method succeeding volumes are easily and quickly figured for as many values of h (height) as desired.

The accompanying drawing shows a cross-section of



SECTION THROUGH CIRCULAR RESERVOIR

an inverted frustum of a cone, corresponding to a cross-section of the reservoir, divided into horizontal sections, whose volumes are represented by:

V_0, V_1, V_2, V_3, corresponding to equal values of h, as h_0, h_1, h_2.

The volume of V_0 is obtained by computing the center section of height h_0 and diameter d and adding to it the volume represented by the area of the triangle $a\ c\ e$ of height h_0 and width r times the circumference at the center of gravity of the triangle. This volume is given by the formula:

$$V_0 = \tfrac{1}{4}\pi\,(d)^2\,h + \pi\,(d + 2/3\,r)\left(\frac{r\,h}{2}\right) \qquad (1)$$

Volumes V_1, V_2 and V_3 are given by the formulas:

$$V_1 = \tfrac{1}{4}\pi\,(d + 2r)^2\,h + \pi\,(d + 2r + 2/3\,r)\left(\frac{r\,h}{2}\right)$$

$$V_2 = \tfrac{1}{4}\pi\,(d + 4r)^2\,h + \pi\,(d + 4r + 2/3\,r)\left(\frac{r\,h}{2}\right)$$

$$V_3 = \tfrac{1}{4}\pi\,(d + 6r)^2\,h + \pi\,(d + 6r + 2/3\,r)\left(\frac{r\,h}{2}\right)$$

The relation between succeeding volumes is obtained by subtracting V_2 from V_3, V_1 from V_2 and V_0 from V_1.

$$V_3 - V_2 = \frac{\pi\,h}{4}\,(4\,dr + 20\,r^2)$$

$$V_2 - V_1 = \frac{\pi\,h}{4}\,(4\,dr + 12\,r^2)$$

$$V_1 - V_0 = \frac{\pi\,h}{4}\,(4\,dr + 4\,r^2)$$

Then:

$$(V_3 - V_2) - (V_2 - V_1) = 2\,\pi\,h\,r^2 = \text{Constant}$$

and:

$$(V_2 - V_1) - (V_1 - V_0) = 2\,\pi\,h\,r_2 = \text{Constant}$$

The next succeeding volume may then be obtained directly by adding to the last known volume the difference between it and the next preceding one plus the constant as follows:

Given V_2 and V_3, to find V_4:

$$V_4 = V_3 + (V_3 - V_2) + 2\,\pi\,h\,r^2.$$

Leaky Subway Station Made Tight

A campaign of grouting has proved successful in stopping serious inflow of water into the new Canal St. subway section and station, New York City, according to a statement of the Public Service Commission. The section extends east from the new Broadway subway to the Centre St. loop subway, passing under the old subway in Lafayette St. In building it, connection had to be made with the existing subway structures in Lafayette St. and Centre St., after tunneling under them. Pumping down the ground-water by wells was resorted to during the construction, in order to facilitate the excavation work. After completion of the station, leakage developed at many points, and ultimately the total inflow reached the amount of 150 gal. per minute. It was necessary to cut channels for the water and provide gutters and pipes at various points, in order to permit the station to be kept in use as a means of transfer between the three subways. The leakage came through breaks at the connection of waterproofing laps on the outside of the structure. To stop them, grout was pumped through holes drilled in the wall of the station. These grouting operations have been carried on for a number of months, and they have been so successful that now the total flow of water into the station is reported at less than 2 gal. per minute. It is expected that when the grouting is completed the leakage will be eliminated.

Improving Concrete By Rodding

Tests Show That Strength Is Increased Materially by Continuous Agitation of Wet Concrete With Rods

By F. E. Giesecke

Head of Division of Engineering, Bureau of Economic Geology and Technology, University of Texas, Austin, Texas

"Rodding" concrete—that is, working a pointed rod of about ⅝-in. diameter into and around the soft mixture, adds considerably to its strength, according to tests made in the laboratories of the University of Texas. The tests were made to determine if this method would have any beneficial effect in removing the excess water which the necessity of a workable mix generally imposes on concrete placed in the field.

Eight groups of specimens, designated A to H, were prepared. Each group consisted of six 6 x 12-in. cylinders of the same concrete composed by weight of

Colorado River gravel P 1½—R ¼	29 7%
Colorado River gravel P ¼—R ¼	29 5%
Colorado River sand P ¼—R 12	12 0%
Colorado River sand P 12—R 50	11 3%
Colorado River sand P 50	3 1%
Blend cement of two brands of Texas cement	14 4%
	100 0%

This mix corresponds very closely to the ordinary 1 : 2 : 4 mix; the resulting concrete contains about six sacks of cement per cubic yard of concrete. The lag of the tests is given in the accompanying table.

The A specimens were prepared with water amounting to 6.7% of the total weight of the other materials, or 46.5% of the weight of cement, or about 71% of the volume of the cement. They were of a very stiff consistency, and were thoroughly tamped while being placed in the molds. All other specimens were prepared with water amounting to 10% of the weight of the other materials, or 69.4% of the weight of the cement, or about 104.5 per cent. of the volume of the cement.

The concrete for the specimens was so thin that it flowed readily and was difficult to handle with shovels. It contained more water than need ever be used in practice to secure easy handling and a thorough filling of the forms.

Of these seven groups, the concrete for the B specimens was deposited in the molds, and as it settled more was added, so that the molds were well filled when the specimens were completed. The C specimens were tamped lightly with a wooden tamper. The D speci-

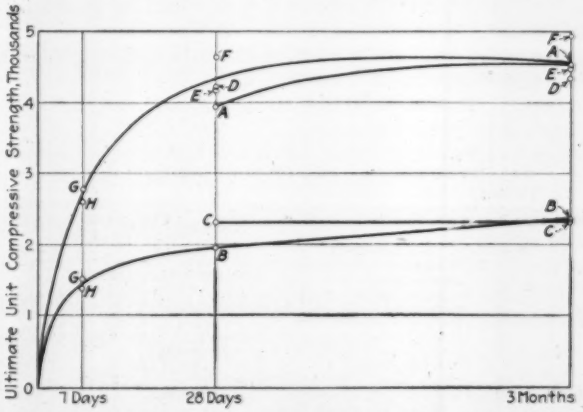


FIG. 1. TIME-STRENGTH CURVE OF RODDED CONCRETE CYLINDERS

mens were rodded every 15 to 30 minutes for four hours, when the concrete had set so firm that the rod would not penetrate more than 2½ in. The E specimens were rodded every 10 to 12 minutes for 2½ hours. The F specimens were rodded every 30 minutes for seven hours. Of the G and H specimens, one-half were rodded every 30 minutes for 7½ hours, and the other half were left untreated, like the B specimens; the G specimens were

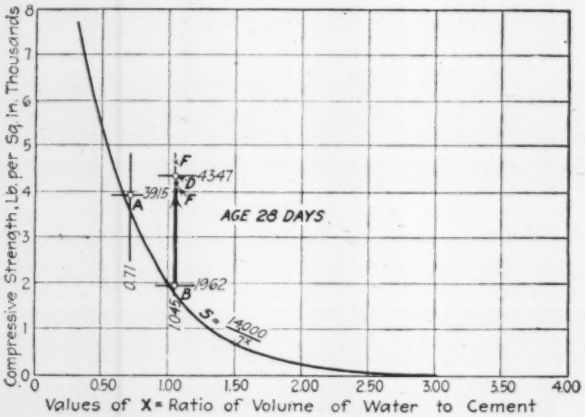


FIG. 2. WATER CONTENT OF SPECIMENS PLOTTED AGAINST STRENGTH

stored under usual laboratory conditions, and the H specimens were left in the molds and exposed to the weather and approximate working conditions.

These average values are shown graphically in Fig. 1. Comparing lines C-C and B-B shows that tamping the soft concrete increased the strength very little. Comparing lines DEF-DEF and B-B shows that rodding the soft concrete increased its strength about 100% at an age of 28 days and over, and about 80% at an age of seven days. Comparing lines DEF-DEF and A-A shows that the soft concrete prepared with a considerable excess water and rodded was stronger than the same concrete prepared with as little water as it was practicable to use.

A very thorough study of the effect of excess water on the strength of concrete by Prof. D. A. Abrams of Lewis Institute led to the value $14{,}000 \div 7^x$ as the ultimate unit strength of concrete at an age of 28 days, x representing the ratio of the volume of water to that of the cement, the latter being based on a weight of 94 lb. per cubic foot. (See *Engineering News-Record* of May 2, 1918, p. 873.) Fig. 2 shows the value $14{,}000 \div 7^x$ and the average 28-day strengths of the A, B, D, E, and F groups of specimens. An inspection of this figure shows that the strengths of the A and B groups, which were not rodded, agree very well with the value $14{,}000 \div 7^x$ and that the rodded groups, D, E, and F, are very much stronger.

TABLE SHOWING EFFECT OF RODDING CONCRETE

	Water Content in Per Cent. of Total Weight	Treatment	Compressive Strength Lb. per Sq.In. 28 Days	3 Months
A	6 7	Tamped	3,915	4,559
B	10	Slowly filled	1,962	2,386
C	10	Tamped lightly	2,313	2,343
D	10	Rodded every 15 to 30 min. for four hours	4,211	4,363
E	10	Rodded every 10 to 12 min. for 2½ hours	4,188	4,512
F	10	Rodded every 30 min. for seven hours	4,644	4,961
G (a)	10	Rodded every 30 min. for 7½ hours; stored in laboratory	2,770	
G (b)	10	Slowly filled; stored in laboratory	1,522	
H (a)	10	Rodded every 30 min. for 7½ hours; exposed to weather; slowly filled	2,611	
H (b)	10	Slowly filled; exposed to weather	1,409	

It seems very probable, from a study of Fig. 2, that the particular increase in strength, about 100%, due to rodding, found in these experiments, was caused by the particular percentage of excess of water used in preparing the specimens, and that the beneficial effect of rodding varies with the percentage of excess water used.

The increase in strength produced by the rodding is no doubt due to the removal of the excess water and the entrapped air and to the compacting of the aggregate. Specimens D, E and F, for example, had an average weight of 147.9 lb. per cubit foot and specimens B a weight of only 142.1 lb. To a certain extent, the excess water may act as a lubricant to permit a better compacting of the aggregate.

Strength Requirements for Manila Rope

SPECIFICATIONS for purchase and acceptance of manila rope recently drawn up for Government use by the Bureau of Standards give figures for required breaking strength according to the table reproduced below. Tests are to be made on pieces not less than 5 ft. long between end connections or splices; at least one coil of each size of rope in a given lot is to be tested, and if the lot includes a large number of a given size from 3 to 5% of the coils shall be tested. If the ends of the test specimens are fitted with eye-splices for test the inside diameter of the eye must be at least 7 in., and the splices must be strong enough to insure a break in the body of the specimen. An unusual clause of the specifications reads:

If not more than 30% of the coils tested fail, the lot, except the coils which have failed, shall be accepted. If more than 30% fail the manufacturer may request and shall be granted a retest of one or more lots of an equal number of specimens taken from the same coil or other coils of the lot. If not more than 30% of the entire number of tests fail, the lot, except those coils which have failed, shall be accepted. Any coil which has failed to

WEIGHT AND STRENGTH OF MANILA ROPE

New Government Specifications, Drawn by Bureau of Standards
Figures apply to three-strand rope, medium-laid. Four-strand rope may run up to 7% heavier and may show 95% of the tabulated strength.

Approximate Diameter in Inches	Circumference in Inches	Approx. Gross Weight of a 1200-Ft., Coil in Pounds	Maximum Net Weight per Foot Rope in Pounds	Minimum Breaking Strength in Pounds
6 thd. ¾	2½	24	0.0196	700
9 thd. 1	3	35	0.0286	1,200
12 thd. 1¼	3½	50	0.0408	1,450
15 thd. 1½	4	66	0.0539	1,750
18 thd. 1¾	4½	78	0.0637	2,100
21 thd. 2	5	90	0.0735	2,450
2¼	5½	126	0.1029	3,150
2½	6	160	0.1307	4,000
2¾	6½	198	0.1617	4,900
3	7	234	0.1911	5,900
3¼	7½	270	0.2205	7,000
3½	8	324	0.2645	8,200
3¾	8½	378	0.3087	9,500
4	9	432	0.3528	11,000
4¼	9½	504	0.4115	12,500
4½	10	576	0.4703	14,200
4¾	10½	648	0.5290	16,000
5	11	720	0.5879	17,500
5¼	11½	810	0.6615	19,500
5½	12	900	0.7348	21,500
5¾	12½	1,080	0.8818	25,500
6	13	1,296	1.059	30,000
6¼	13½	1,500	1.225	34,000
6½	14	1,764	1,441	38,500
6¾	14½	2,016	1.646	4?,500
7	15	2,304	1.881	49,000
7¼	15½	2,580	2.107	55,000
7½	16	2,916	2.381	61,000
7¾	16½	3,240	2.645	67,000
8	17	3,600	2.940	73,000

meet tensile requirements on the first test shall be accepted if two subsequent tests prove satisfactory.

The size and weight of the rope are to be determined while the rope is stressed by a load in pounds equal to 200 times the square of the diameter of the rope in inches. The weight per foot is also determined on the basis of the length of the rope when stretched under this load. A tolerance on circumferential measurement of size is allowed, ranging from $\frac{1}{8}$ in. for rope from $\frac{3}{4}$ to $1\frac{3}{4}$ in. in circumference, to $\frac{3}{8}$ in. for rope $9\frac{1}{2}$ in. and over in circumference. The weight tested is used, in case the rope overruns the tabulated weight, for reducing the billed weight in the same proportion as the overrun of the weight per foot.

It is specified that rope shall contain not less than 8% nor more than 12% of lubricant content. No non-manila fiber must be present in the rope, as indicated by the brown coloration of manila and red coloration of other fibers after treatment with acidified bleaching-powder solution followed by exposure (when dry) to strong ammonia fumes.

Concrete Mat and Columns Reduce Cost of Building

Heavy Foundation Work Avoided by Concrete Mat Over the Site—Columns Have Cast-Iron Core with Rods and Spirals

TO AVOID excavation in quicksand, and other expensive work in soft soil, a reinforced-concrete mat covering the entire area of the site was used for the foundation of the 10-story Blatt apartment building, which was erected in Chicago in 1917. Concrete columns of the Emperger type, with cast-iron pipe cores, were used in the same building. Street columns and reinforced-concrete floors were provided in the original design, but concrete construction was adopted on account of the high cost and uncertain supply of steel. The cost of the concrete columns and floors is said by the designer to have been only about 55% of that estimated for the steel work thus eliminated.

Situated near the lake shore, the site, about 106 x 160 ft., has the sidewalk elevation 14 ft. above lake level and only 6 ft. above ground water. The ground consisted of 20 ft. of fine sand over 30 ft. of soft clay.

Footings on wood piles were called for in the original design. Under the Chicago building code, however, the piles would have to be cut off 12 in. below lake level. This would have required 15 ft. of excavation, 9 ft. being in water-bearing sand or quicksand, necessitating the inclosure of the site with steel sheeting. The cost of such foundation work would have been prohibitive. Concrete piles also would have been expensive, as they would have had to be at least 40 ft. long.

A flat-slab raft or mat foundation which would give a load of not more than about 2000 lb. per square foot was then proposed. This was adopted, and the work was completed within six weeks. The slab is 24 and 20 in. thick, made of 1:2:4 concrete. Reinforcing bars are arranged as shown in the drawing. Special $\frac{3}{4}$-in. bottom bars in the spaces between the columns are provided for taking up the negative moment, and 1-in. bottom bars under the columns are provided for the same purpose. Both sets of rods are 10 ft. long.

To limit the shear to about 75 lb. per square inch, column footings or pedestals of 1:1:2 concrete were built on the slab. Each footing is 30 in. high, $5\frac{1}{2}$ ft. square at the base and $3\frac{1}{2}$ ft. at the top. It is reinforced with a 25-in. spiral of $\frac{1}{4}$-in. wire with 1-in. pitch, in order to allow the high compression load which the columns concentrate on the cast-iron base-plates.

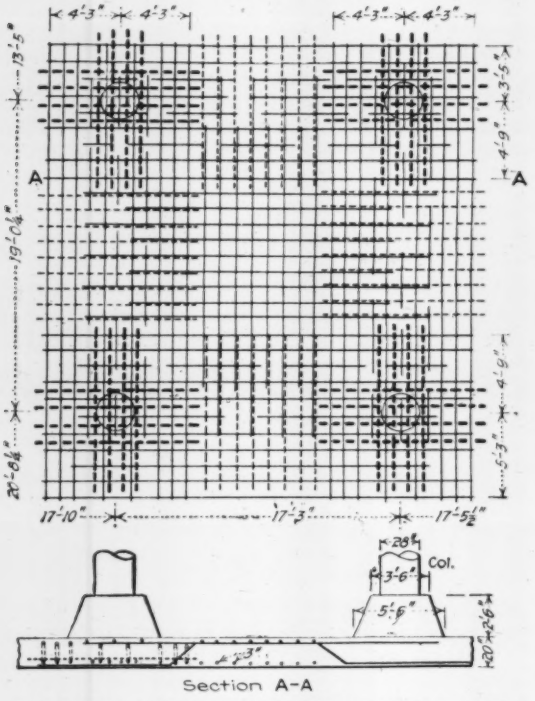
Columns of the Emperger type, having cast-iron pipe cores, form one of the special features of the structure. The cores were plain cylindrical castings, poured vertically. They were mainly of 5- and $9\frac{1}{4}$-in. outside diameter, the thickness varying from $\frac{1}{2}$ to 1 in. for the former and $\frac{7}{8}$ to $1\frac{1}{2}$ in. for the latter. Butt joints were made about 2 ft. above each floor line, spliced with outside sleeves, as shown. Three 12-in. dowel rods were embedded in the concrete filling, in order to line up the columns and prevent lateral shifting. Cores for the basement and the first floor were cast in one piece, as the basement is only a 6-ft. pipe chamber, so that the height of these tall cores did not exceed 15 feet.

Dowel bars in the columns extend from the bottom of the concrete slab to about 30 in. above the first floor, as shown

FOUNDATION SLAB AT BASEMENT IS READY FOR SUPERSTRUCTURE

in one of the drawings. There are 12 of these bars to each column. In the wall columns eight bars are on the outer side, with their horizontal bottom ends bent toward the inside of the building. The other four bars are on the inner side of the column, with their ends bent toward the outside of the building. All the rods lie within the spiral hooping of the column base and column.

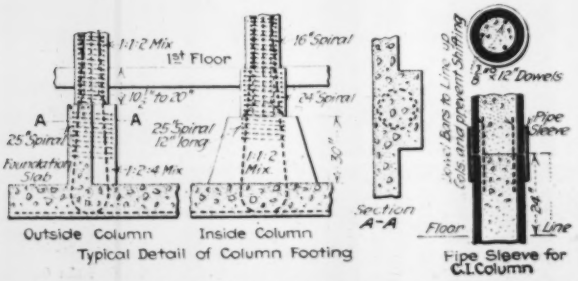
Above the first floor the columns were made of the same sizes as those originally provided for steel con-



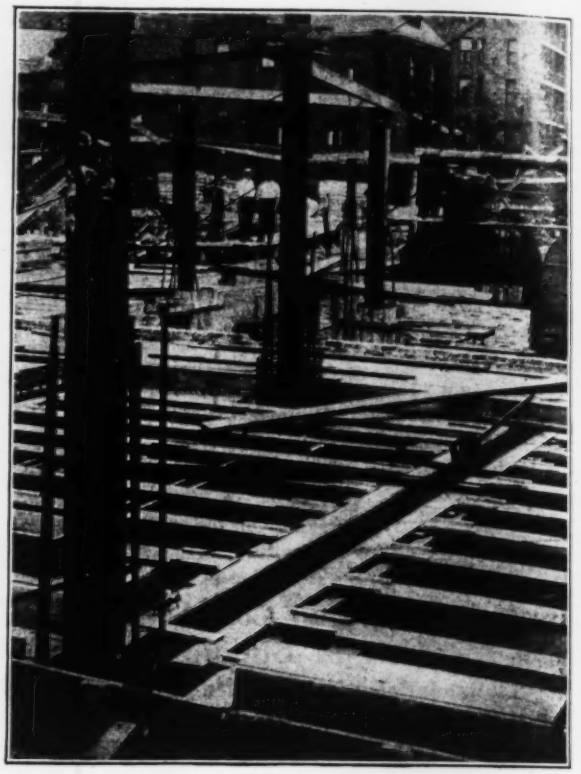
CONCRETE MAT IS FOUNDATION FOR 10-STORY BUILDING ON SOFT GROUND

struction with concrete fireproofing. The short stub columns in the basement were made larger than the original design and were provided with pyramidal concrete bases, as already described, in order to distribute the load and thus reduce the punching shear on the concrete mat which forms the foundation of the building.

Concrete of 1:1:2 mix was used for the interior filling and exterior casing of the core, the latter being 1½ in. thick outside of the steel spiral which surrounds the vertical reinforcing rods. To meet the safe-load requirement of the Chicago building department, the



CONCRETE COLUMNS HAVE CAST-IRON CORES—BENT BARS ANCHOR THEM TO THE FOUNDATION SLAB



CAST-IRON CORES READY FOR COLUMN FORMS—FLOOR FORMS IN PLACE

vertical reinforcement and spiral were each made 1% of the cross-sectional area of the iron core. Stress on concrete over full core area, inside spiral, was taken as 1120 lb. per square inch. Stress on cast iron was taken as 11,200 lb. less the 1120 lb., or 10,080 lb. per square inch.

R. W. Wilson & Co. were the architects. The adopted foundation and columns were designed and built by L. J. Mensch, contracting engineer. These plans were checked by the Westcott Engineering Co., consulting engineers for the architects.

Decrease in Lumber Production in 1918

Recent tables compiled by the United States Forest Service show that the State of Washington, with a record of more than 3,250,000,000 ft. of lumber cut in 1918, Oregon with 2,000,000,000 cut and Louisiana with a cut of more than 1,500,000,000 ft. are still the great lumber-producing states of the country, with Mississippi, California and Nevada (the two in one division), Wisconsin, Arkansas, Texas and Idaho each cutting more than 500,000,000 ft. each. A total lumber production of 32,760,000,000 ft. is the estimated cut for 1918 on the basis of partial returns received by the Forest Service from 731 sawmills, each of which cut 5,000,000 or more feet in 1917 or 1918.

In 1917 the total production of lumber in this country amounted to 36,000,000,000 feet. The decrease in 1918 is not confined to any one region but is general. It is largest in the Southern and Eastern states and least in the Western states. Maine shows the greatest percentage of decrease.

Short-Circuiting Floods in the Big Sioux River

Two Thousand Second-Feet of Floodwater Dropped 110 Feet in Distance of 300 Feet Through Canal at Bend in River—Hydraulic Jump Takes Energy Out of Fall

By Francis C. Shenehon
Consulting Hydraulic Engineer, Minneapolis, Minn.

FLOODS in the Big Sioux River near Sioux Falls, S. D., are to be guarded against in the future by the Sioux Falls spillway, designed to pass 2000 cu.ft. of floodwater per second through a descent of 110 ft. in a distance of 300 ft. The spillway not only conducts the water but serves to absorb the destructiveness of its great energy. This absorbed energy is better comprehended by thinking of it as 25,000 theoretical horsepower.

The Big Sioux River, approaching Sioux Falls from the north, passes south tangent to the city, then makes a loop of 26 miles of meandering course, and returns through the city. The descent of the river over a bed of red jasper or quartzite rock creates a water power about which the city has centered and grown. The developed fall is 62 ft. The river departs northward again flowing in a deep gorge, and having a water surface level about 115 ft. below the surface level of its first tangential approach. From the upper river to the lower river across the neck of the loop is about 2½ miles, and this is the short cut for the diversion of floodwaters.

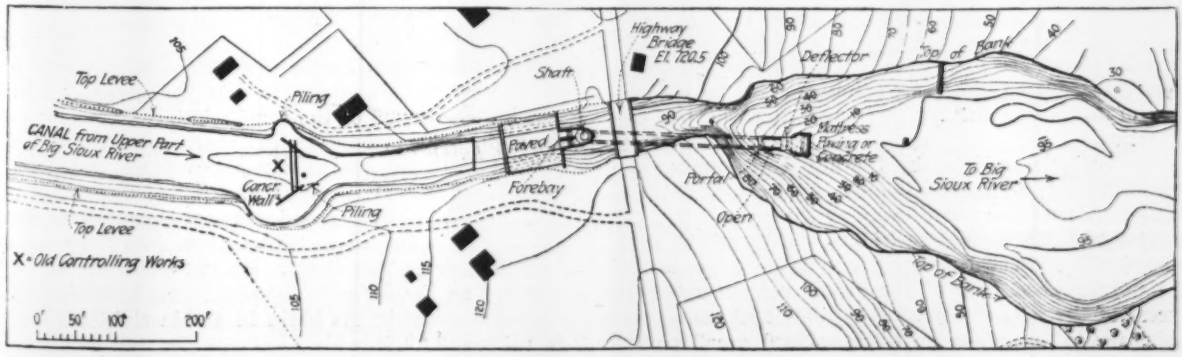
The river as it comes from the north has a drainage basin above Sioux Falls of 4450 square miles, the headwaters lying in the Heights of the Prairies in the northeastern part of the state. It has the characteristic devious, winding course of a stream flowing in banks little depressed below meadow lands. Its travel in reaching Sioux Falls appears as much as 300 miles with slopes not much exceeding 1 ft. to the mile. Between 1% and 2% of its drainage basin consists of lakes which have a slight tendency to detain the floodwaters and stabilize the flow. The normal annual rainfall is about 23 inches.

The southward flow of the river, with the ice disappearing downstream first and clearing the way for the later floodwaters from up-state, is not favorable for excessive flood volumes in the spring breakup. The corridor shape of the drainage basin, and its flat slopes, tend to the slow development of floods, and the lesser probability of synchronizing flood peaks. No records were available of flood flows. From high-water marks, channel dimensions and slope considerations, the writer's estimate of the bank-full flood flow was 6000 cu.ft. per second; or 1.35 cu.ft. per second per square mile of drainage basin. The spillway was designed to carry one-third of this normal flood flow, with some overload capacity.

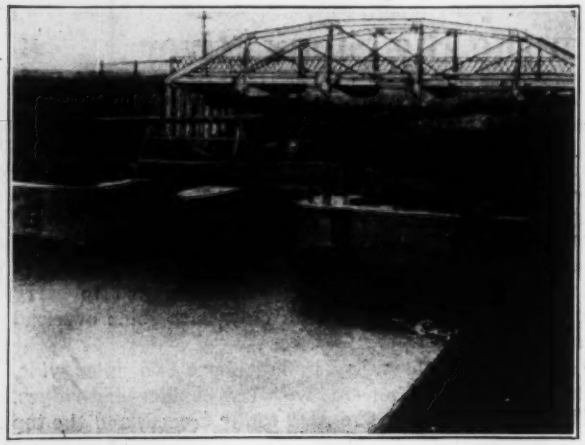
The upper river valley is flat, about two miles wide, and rimmed on either side with low boulder-clay ridges. The valley subsoil is fine sand easily eroded, and the top soil is a black clay loam enriched by centuries of overflow. The lands bear abundant crops and are valuable. The river channel is but slightly depressed in the valley floor, and in the past it has shifted to some extent.

WRECK OF OLD SPILLWAY, FLOOD OF MARCH, 1916

It was an obvious expedient to ditch this land for drainage purposes, and to give these ditches an outlet through the south rim of hills into the river of the gorge. These ditches were made large enough to divert water from the upper river across the neck to the lower river, and thus relieve the congestion of flood-time in



PLAN OF SPILLWAY TO TAKE FLOOD WATER ACROSS LOOP OF BIG SIOUX RIVER, NEAR SIOUX FALLS, S. D.



FOREBAY AND SLUICEWAYS AT HEAD OF SHAFT OF NEW SPILLWAY

the loop. One ditch taps the river 12 miles up the valley, and a second almost abreast the north edge of the city.

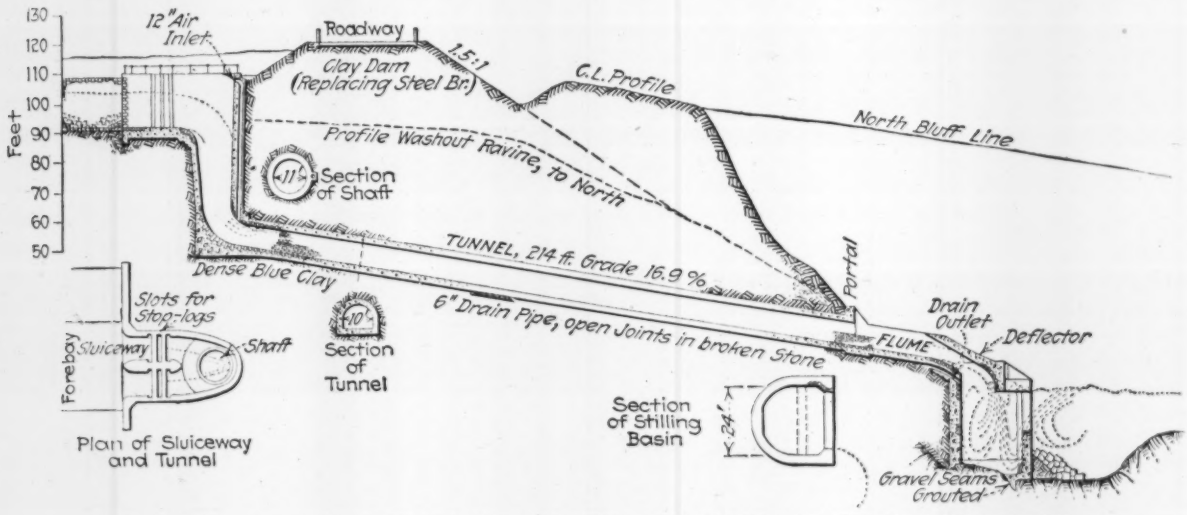
To bring these waters from the valley floor to the lower level, some ten years ago a cut was made through the valley rim and down the sloping river bank, and a reinforced-concrete trough lining was constructed. The destructive energy carried in the surcharged trough was perhaps not fully appreciated; and in the flood of March, 1916, the torrent cut out the protective works at the outlet end, and, by undercutting, tumbled the trough into a mass of broken concrete at the bottom of a gorge excavated 800 ft. back into the sloping hillside. One of the views shows the trough in process of destruction.

The writer was called by the board of county commissioners of Minnehaha County, in August, 1917, to design and construct a spillway of ample capacity.

As stated, the normal desirable capacity of the spillway (2000 cu.ft. per second) was taken as one-third the normal flood flow of the river, and somewhat in excess of the normal bank-full capacities of the ditches tributary to it. When an extreme flood overflows the ditches and brings water overland, increased depth in the spillway sluices will give an overload capacity of 2500 cu.ft. per second.

The geological formations and the topography determined the type of the spillway structure. The walls of the gorge cut at the time of the wrecking of the old trough spillway revealed an underlying stratum nearly 100 ft. thick of tough, rubber-like bluish-gray clay, which in the glacial epoch had been compacted by the enormous pressure coming from an ice sheet a mile or more in thickness. Above the blue clay was a cover of yellow clay of little tenacity. The blue clay at an unknown depth was underlain by the red quartzite rock. It was decided to penetrate the blue clay by shaft and tunnel and thus take the shortest route to the gorge, where a confined stilling basin at the outlet could be founded on rock and have a rock bottom.

The spillway as perfected was made up of simple elements. Controlling works were placed at the upper end, with sluiceways limiting the inflow to 2000 cu.ft. per second with water at El. 104. The sluiceways are provided with stop-logs to shut off the flow when desirable. Above the sluiceways the ditch is enlarged into a forebay and paved. A stilling basin is at the lower end, where the flood waters are made to plunge into a well, 25 ft. deep, U-shaped and equivalent in horizontal area to a circle 24 ft. in diameter. A conduit leads from the sluiceways to the stilling basin. It was designed to destroy energy, so the conduit first drops vertically in a circular shaft tapering to a diameter of 10 ft. at bottom. Then an elbow turns the water through an angle of 80° into a tunnel 10 ft. wide and 8 ft. high, with circular arch overhead. The tunnel is 214 ft. long and descends on a 16.9% grade. Then comes an open flume of the same width, with sidewalls 8 ft. high, bridged between the tunnel portal and the basin, so that the earth may settle from under its floor without endangering its stability.



SECTION THROUGH SPILLWAY CANAL AND TUNNEL SHOWING DETAILS OF STILLING BASIN

The flume leads to a curved deflector beam, where the flood stream is turned vertically down into the center of the well or stilling basin. As the water is turned downward on the deflector it spreads out laterally and strikes the water in the basin in a thin sheet perhaps 2 ft. thick and 20 ft. wide. Perhaps the well should be called a seething basin instead of a stilling basin, be-

FLOODWATER COMING FROM TUNNEL INTO STILLING BASIN CUTS ITS OWN CHANNEL

cause the water is not stilled when it issues from the basin in a stream 20 ft. wide and 15 ft. deep, but is alive with energy. The final absorption of the residual energy takes place in the open gorge downstream from the basin, where the rock bottom is at a depth of 30 ft., and the stream is free to cut out for itself a channel 100 ft. wide if it needs it. Sixty feet downstream from the basin the floodwater flows tamely away.

The original intention was to confine the secondary turbulence and expansion within concrete walls extending 80 ft. downstream. Since, however, this secondary turbulence could excavate in the gorge its own deep basin without cost and without danger to the stilling basin on its rock foundation, it appeared sound to regard the concrete extension as redundant, and to save its cost. This hydraulic excavation of the outer basin was successfully accomplished in an eight-day flood in March of this year. The flow was restricted by stoplogs to 1200 cu.ft. per second and the gorge walls were brought down in little landslides which did not endanger the structure. The lateral eddies were not allowed to advance unduly upstream. When the outside basin dimensions have been worked out by the floodwater itself, a fillet of heavy rock fragments will be made outside the basin and downstream from the sill, and a heavy cover of rock will be placed at the sides of the basin where the slow swing of the eddies tends to encroach upstream.

One geological feature is still to be explained. The rubber-like blue-gray clay rests on a stratum of fine quartz sand, which at the basin was 20 ft. in depth. This sand yields a small spring flow. It is not quicksand and does not flow, but where exposed to current wash it undermines the blue clay and causes the landslides mentioned above. When a condition of equilibrium is reached, the blue clay has formed a talus bank which confines and protects the sand from further wash. The clay itself does not scour readily.

The principle involved in the absorption of energy in the stilling basin is that of the hydraulic jump, or standing wave, in which a stream of high velocity and small section undergoes a transition to a stream of low velocity and large section. It has been much discussed of recent years in connection with the detaining reservoirs of the Ohio flood-relief projects.

The object of projecting the swift stream vertically downward into a deep well is to make the structure shorter and more compact. This feature was suggested by Adolph F. Meyer, associate professor of hydraulic engineering in the University of Minnesota, who at my request made experiments in the hydraulic laboratory to test the action of vertical jets in a confined pool. Desirable depths and basin dimensions were recommended by Mr. Meyer, but he is not chargeable with the final dimensions adopted or with the omission of the extended basin to contain the secondary turbulence and expansion.

By the Unwin equation a stream 2 ft. deep, with a velocity of 50 ft. per second will have, as its "alternate" after the hydraulic jump, a stream 16.7 ft. deep with a mean velocity of 6 ft. per second. A stream 2 ft. deep flowing at 60 ft. per second will have, after the transition, a depth of 20.2 ft. The velocity of the stream plunging into the well will be between these limits. The well is 25 ft. deep and the depth over the outlet sill is 15 feet.

All structures are of reinforced concrete of massive design. Perhaps the forces to be cared for may be more readily grasped when it is stated that at overload capacity 4700 tons of water per minute are speeding at 35 miles an hour vertically through the shaft, turned nearly to horizontal in the elbow, turned to vertical on the deflector; then flow out of the basin horizontally again. The reaction in the elbow and on the deflector is over 100 tons.

The two sluiceways, each 8 ft. wide and 12 ft. deep at normal flood flow, admit substantially 2000 cu.ft. per second. The duplicate sluices prevent vortex in the

shaft. When the flood is 2 ft. higher, some lands in the vicinity of the spillway are flooded, and some water passes overland back to the upper river further downstream. The sluices under this condition will admit 2500 cu.ft. of water per second. In extreme floods, coming at wide intervals, this depth is expected. When coming in March or April the temporary flooding of some lands will create no large damage. Such a flood means water coming overland from up the valley, the river and the ditches overflowing.

How the Shaft Was Built

The shaft was excavated through the tough blue clay 40 ft. deep and 15 ft. in mean diameter, without shoring. No forms were used, the facing wall of jasper and the clay surface forming the mold into which the concrete was poured. After the tube of reinforced concrete had set over a period of 10 summer days, the excavation was carried down to the base of the elbow, undermining the 120-ton tube. This tended to settle it, like a cork in a bottle, imperviously into the clay.

The tunnel heading was driven from both ends, the dense clay being blasted out with dynamite, and being carved into shape, 12 ft. high and 14 ft. wide, without timbering. One exception to this was over a length of 20 ft. where a pocket was encountered, which precipitated about 200 cu.yd. of wet sand and gravel into the heading. The jasper-faced floor and side walls to a height of 4 ft. needed no forms. The arch was carried on portable forms. All the rock facing was set integral with the concrete.

The basin presented the only really difficult problem. Suitable rock foundation lay at a depth of 25 ft. below water and through 20 ft. of sand. The site was hemmed in by clay bluffs, 100 ft. high, with slopes too steep for stability. Landslides were not uncommon. The basin construction is a story in itself. Pneumatic caisson was clearly indicated, but it was shoved through inside a circular ring of steel sheetpiling. The basin with the deflector and half the flume weighs nearly 700 tons. Its walls are locked to the rock, and it is anchored by the steel of the flume to the earth-bound tunnel against the heavy earth pressure and the water impact.

The spillway was built under the direction of the Board of Commissioners of Minnehaha County, South Dakota. The Sioux Falls Construction Co. executed the work. L. M. Norelius was resident engineer during the most difficult period.

Origin of English Weights and Measures

According to a letter formulated by the World Trade Club advocating universal adoption of the metric system, the present coinage of the British Isles, as well as the weights and measures of both the British Isles and of America, is German. The British pound, both sterling and avoirdupois, originated with the old German Osterling Hanseatic League, which for hundreds of years controlled the trade of England. What is still more remarkable is that America and Britannia continue to use these old German tools after Germany herself has forgotten them. The latter country adopted in 1871 the simplest decimal system of quantity expression known—the application of the decimal to weights and measures, the invention of that truly great Briton, James Watt, in 1783.

Frozen Concrete Thawed by Putting Warm Concrete on Surface

It Is Also Found That Chemical Changes in Setting Concrete Produced Enough Heat To Prevent Freezing

WARM concrete placed on the frozen surface of a previous layer was reported as thawing out the latter, in the construction of the Dead River dam, in northern Michigan, as described in an article in *Engineering News-Record* of Aug. 8, 1918, p. 260. Similar behavior is now recorded in the construction of the East Canyon Creek dam, near Ogden, Utah, described in a paper by A. E. Parker in the "Proceedings" of the American Society of Civil Engineers, March, 1919. In addition, the engineers on the Utah dam concluded that the chemical action by the setting concrete developed enough heat in itself to prevent damage from freezing. The particulars of the concreting work are recited by Mr. Parker as follows:

Most of the sand was in a large pile on the side hill above the two bins and, becoming wet from the autumn storms, it froze to a depth of 2 or 3 ft. The broken rock was coated with frozen earth, snow and ice. Although the bins were roofed, the materials often froze. The only thing done to overcome these conditions was to mix the concrete with hot water. The concrete as it came from the mixer was just above the freezing point, and to maintain it at this temperature it was necessary to keep the water hot and to throw out the larger, solidly frozen lumps. It was planned to use rock plums in the concrete, but cold weather prevented this, as it was too difficult to remove the snow, ice and dirt from the rock.

Rise in Temperature Prevented Damage

Experience soon showed that the rise of temperature due to chemical changes in setting prevented damage from frost when the concrete in the forms was covered at night. Canvas was spread over the forms, steam jets prevented surface freezing, and the temperature of the mass below the surface soon increased sufficiently to remove any frost occurring there, if not too great in quantity. As the steam caused heavy deposits of frozen moisture on the forms, which in melting made a very sloppy condition, salamanders burning coke were substituted for the steam jets, bringing about an improvement of conditions.

When concrete was placed on very cold days the surface of the fresh concrete often froze immediately to the depth of an inch or two. It was found that placing fresh concrete thickly over such a surface quickly thawed it out without harm, but when the freezing was too severe the frozen part was picked, broken up and thrown out. Steam jets were used freely to thaw out and remove the ice from the forms, concrete surfaces and rock walls immediately before concrete was placed against them.

The removal of the 1¼-in. pipes in the contraction joints afforded a favorable means of testing the rise in temperature in the concrete when setting. Thermometers lowered into the holes showed in every case a considerable rise, a typical test showing a temperature of 70° F. at a depth of 15 ft. when the air was at 14° Fahrenheit.

A Map-Indexing System Adapted to Small Cities

Number Book, with Simple Classification Scheme Combined with Four-Color Card Index, Used at Riverside, California

By Frank J. Calkins
Riverside, California

NUMEROUS schemes for systematizing the filing of maps and other engineering data in large cities are on record, but very little information is to be found concerning indexing systems suitable for smaller cities, say of 10,000 to 50,000 population. The system developed by the writer for the City of Riverside, Calif., may be useful to others who have met the same difficulty. It is believed that the system will serve until a city has grown to such size that the city engineer's office is divided into several departments.

The objection to systems used by many small cities is that they leave too much to the memory of officials in charge. In developing a better system it was the purpose to eliminate this element. As finally revised, the plan includes a card index and a number record book. These two parts of the system are expected to afford so effective a means of cross-reference that there will never be delay or difficulty in locating the desired map.

The number record book was selected with a view to the strongest and most durable binding. Its page size is 9½ x 13½ inches, with ordinary record-book ruling.

Three numbers were placed on each page, the plan being to reserve one-third of the page for each entry and thus avoid the use of any subnumbers. The description of an article entered under each number is very brief; just enough to trace it in the card index. Thus the space allotted for each number is enough so that as old work is taken out of the files and replaced by new plans or maps the first record under any number can be canceled and the blank space below it used for later entries.

In the front of the book several pages were specially ruled for use as a chronological index of the numbers. In these pages the entries consist of date of entry and number, only. Their purpose is to facilitate finding the entry for a plan about which there may be some confusion in the index, or whose classification has been forgotten. If the approximate date of filing is known the chronological record makes it possible to turn immediately to the entries made about that time.

Another set of pages, with special ruling, in the front of the book is reserved for vacated numbers. That is, when articles are permanently removed from the files and the entries in the book are canceled, the numbers are listed in the vacated-number record, thereby indicating that these numbers are available for new entries. As these numbers are again used for new entries they are crossed off this list.

The index cards are 5 x 8 in. in size and are ruled and printed alike in four different colors—yellow, salmon, blue and white. Other colors, of course, could be added as further classifications were necessary. Yellow cards are used for all street work and alley work, and improvements such as bridges, culverts, profiles, cross-sections, surveys and lighting systems. Salmon cards are for sanitary-sewer records, including sewer farms, manholes, etc. Blue cards are for drainage work, including drainage sewers, ditches, manhole plans, etc. White cards are used for miscellaneous records, including plans, profiles, notes pertaining to parks, schools, public buildings, water systems, etc. The cards are always kept in the index case in the order of yellow, salmon, blue and white.

The column on the index card marked "Kind or Book" is used for describing the kind of paper upon which the map is drawn, or, when field notes are indexed, this column gives the field-book number, and in the "Map No." column following, the page number of the field book is given.

A key card kept in front of the index bears the following explanation of the system: (1) Maps are first indexed in the number-record book; next in the chronological record, and finally in the card index; (2) the heading typed on the index cards should begin over the letter "N" in the word 'Description"; (3) cards are placed in the file in the following order: yellow, salmon, blue and white; (4) all articles are to be cross-indexed as completely as possible; (5) the sign on the index cards shows that the article indexed covers more work than is shown on that particular card; (6) when a map or a plan is taken from the files permanently the number must be entered in the vacated-number list in the record book and note made in the record book and on the card index stating the date and the cause of removal; (7) when vacated numbers are used again such numbers must be crossed off the vacated-number list. As for the plans and maps themselves, they are kept in paper tubes riveted together with eye-rivets, in sections of 50 tubes each; each section just fitting into a space in a wooden rack built in a fire-resisting vault. The tubes are 2 in. in diameter and 36 in. long, and the rack can hold 900 tubes. The tubes are not fastened to the rack and can be removed whenever desired. This size has been found large enough for all practical purposes. The wall space occupied by the rack is approximately 5½ ft. square, while the floor space

MAGNOLIA AVE.

NATURE	COMPLETE DESCRIPTION	DATE	KIND OR BOOK	MAP NO.
Map	Terracina Drive to Jurupa Ave. Improvement map (macadam)	4/3/17	Tracing	437
Notes	Fill across arroyo. Preliminary	3/12/17	132-12	
Map	Fill across arroyo. Preliminary	10/4/17	Detail	542
Profile	Jackson St. to Van Buren St. For grading	9/30/18	Pro. cloth	566
Map	Lighting System across arroyo	1918	Tracing	573
Plan	Culvert at Washington St. Concrete. 38" by 48" by 96'	4/6/18	Detail	581
Contour map	for fill across arroyo (scale 100')Drawn by G.R.W.	1917	Detail	395

STREET INDEX CARD USED WITH RECORD BOOK

required is about 4 x 5½ ft. The tube numbers are marked upon the wooden strips which border each space in the frame. Units are marked on horizontal strips and tens and hundreds on vertical strips.

Center Gutter Construction Used on Bituminous Street

Sidewalks With Unequal Exposure Utilized as Curbs on Narrow Streets—Plan Helped to Save Trees and Was Economical

By W. D. Johnston
City Engineer, Waterloo, Iowa

BITUMINOUS-surfaced pavement depressed at the center to form a gutter has been used with success in Cedar River Park Plat, Waterloo, Iowa. By utilizing the sidewalks as curbs, and building them with unequal exposures on opposite sides of the street to compensate for differences in elevation, many shade trees, rustic fences, etc., were saved, and a satisfactory and economical improvement was obtained. While streets with center gutters have been constructed elsewhere, it is not known that similar methods and materials were used.

Cedar River Park Plat, on a sandy ridge adjoining the river, was laid out, for the most part, following the rectangular system. The lots were 40 ft. front by

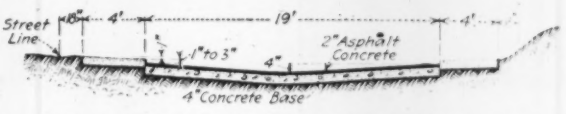
COMPLETED STREET SHOWING WALKS AND TREES

80 ft. in depth, and the streets were 30 ft. wide, with no alleys in the plat. The first stage of its development had been the building of a number of rather small, temporary cottages for summer occupation only; but as time went on additions were made to a considerable number of these and they were reconstructed into permanent homes. This led to a demand for permanent improvements such as sewers, sidewalks and pavements, for the small lots with the increasing number of outside toilets soon proved a nuisance, and the sloping, sandy streets washed away badly with each rain.

In the selection of a type of cross-section for the walks and pavement, the deciding factors were as follows: Rather low property values; sandy soil; fairly steep grades on most of the streets, and the presence of many shade trees, rustic fences, shrubbery, etc., on or near the street lines. After considerable study, the plan and cross-section shown were adopted.

Walks 4 ft. wide were constructed 1½ ft. outside the property line in an effort to leave the trees, shrubs and rustic fences undisturbed. The curves at intersections were built with 4-ft. radii on the inner side and an 8-ft. radius on the outer side. After the walks and sewers had been constructed bids were taken on several types of paving, and the contract was let in February, 1917, on 2-in. asphaltic-concrete surfacing with 4-in. concrete base, at $1.54 per square yard.

In carrying out the construction, a few places were encountered where the transverse slope was excessive and, to avoid throwing the center gutter too far toward



SIDEWALKS ABUT AGAINST CONCRETE BASE AND CONFINE BITUMINOUS SURFACING

the low side, an exposure of ½ to ¾ in. on the low walk, as against 3 to 3½ in. on the high walk, was resorted to, giving the desired result. A view of the completed street is shown.

The cost of the improvement to corner lots where both streets were paved was $190, while for interior lots it was $90, being a portion of the cost of side-street paving and a pro rata part of the total intersection cost. By the elimination of the side curbs a saving of approximately $38 to the corner lots and $26 to interior lots was effected.

Electrical Equipment for Movable Bridges

THE electrical equipment for various types of movable bridges—swing bridges, lift bridges and bascule bridges—is about the same, according to H. H. Vernon, of the power and engineering department of the General Electric Co., in the *General Electric Review*. Both alternating and direct current are used successfully. Standard practice for alternating curent, as illustrated in equipment for a double-leaf bascule bridge, adopts for the main operating power slip-ring motors with normal torque twice that required to overcome the friction of the bridge. Starting torque should be at least twice normal torque. This is necessary in order to provide sufficient torque to overcome static friction under adverse conditions, and to open and close the bridge when a high wind is blowing. The motors drive through a pinion which is either mounted on the motor shaft or on another shaft connected thereto by means of a coupling. Spring-set shoe-type solenoid brakes capable of holding 75 to 100% of the motor torque are mounted on the collector-ring end of the motor The spring-set brakes are used in order that they may be effective at any position of the motor when opening or closing the bridge. The brakes must be arranged so that they can be released by hand, because it is sometimes necessary to operate the bridge on failure of power. Emergency brakes of the spring-set type to hold from 100 to 125% of the normal torque of the motor are mounted on an extension of the motor shaft. Standard solenoid brakes can be obtained to hold 2800-lb. torque at 1-ft. radius.

Either drum controllers or panels containing magnetic switches are used. The lock motor is almost always of 5 hp., of the totally inclosed squirrel-cage type, arranged with metalline bearings and a spring-set shoe type solenoid brake so that it can be tilted at an angle of 90° in a direction at right angles to the shaft. A geared-type limit switch is used for each leaf of the bridge to shut off power from the motors when the leaves have reached their upper and lower limits, and, in addition, to show by means of lamps the open, nearly open, nearly closed and closed positions of the bridge. In order that the power

may not be applied to the lock motor until after the bridge has closed, a track-type limit switch is used that opens as soon as the bridge leaf opens.

In direct-current equipment, the main operating motors are of the series-wound totally inclosed crane or mill type, for which the normal torque should be about twice that required to overcome the friction of the bridge. The motors are arranged with either grease-cut or oil-waste lubrication, so that they will operate successfully when tilted to an angle of 90°. The solenoid brakes are of the same type as that used for alternating-current equipment.

Demobilizing Equipment of Spruce Production Division

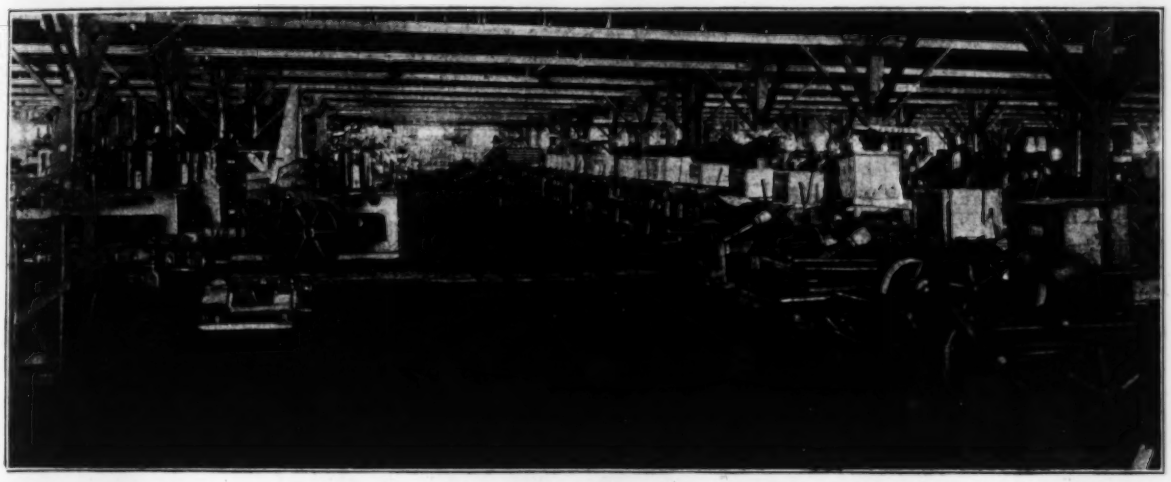
System for Inspecting and Recording Keeps Order Among 4800 Classifications—Receipts up to 45 Carloads Per Day Soon Fill 50-Acre Tract of Yards and Warehouses

A WELL organized force of 50,000 men can operate a large amount of logging and sawmill equipment in these days of highly developed machinery. When the armistice was signed, the Spruce Production Division of the Army had great quantities of equipment in the Northwest to demobilize and an endeavor was made to collect it as quickly as possible during the rainy season, and then to dispose of it without disrupting local market conditions. This required also the classifying, inspecting, recording and labeling of each item as it was received, the provision of such weather protection and repairs as were necessary, and when the material was stored, marked and appraised, to find a buyer at a price which would not be unfair to the trade. That, in brief, was the final task set for the organization whose wartime achievements were reviewed in *Engineering News-Record* of Dec. 5, 1918, p. 1023.

The point selected for the collection of the equipment was the cut-up plant at Vancouver Barracks, near Portland, Ore. To this center, shipments were made from about 160 subcenters of assembly at mills or camps in the woods. Each consignment contained a miscellaneous assortment, and, when coming in at the rate of 45 carloads per day, as occurred in January, a good deal of time and attention was required before each item could be delivered to the particular location assigned in the 50-acre tract of yards and warehouses.

There was no time to build new warehouses—in fact, shipments began to come in a full month before work stopped in the big cut-up mill for which the Vancouver tract was laid out. Therefore, as fast as the equipment arrived that required cover, storage space had to be found in the barracks, lumber sheds or kilns. By the time the mill could be shut down and its equipment dismantled, every foot of floor space under the many acres of roofs had been laid off in bays and sections and assigned for storage of classified materials.

For example, in one part of a shed something over 300 ft. square, long tiers of bins were built into which pipe fittings of several hundred varieties and sizes could be conveniently segregated. Across the aisle, racks were built up in which to lay pipe of various sizes that came in with every shipment. Other parts of the same shed were used for railway, blacksmith and grading tools, stoves, pumps, tanks and some 300 other classifications. The interior of one of these storage sheds is illustrated.



STORAGE BAY IN ONE OF THE VANCOUVER WAREHOUSES

There were 4800 classifications on the list, all told. However, for convenience in handling records everything was included under one of 20 general headings, as shown in the table:

GENERAL CLASSIFICATIONS OF LOGGING AND SAWMILL EQUIPMENT

Letter	Number	Description
R.R.	1	Locomotive and repair parts and equipment
R.E.	2	Railroad cars, repair parts and equipment
L.	3	Logging engines, repair parts and equipment
L.E.	4	Cable, blocks and rope
B.	5	Boats and parts
G.	6	Grading tools and machinery
P.	7	Pile-driver and equipment
S.M.	8	Sawmill machinery supplies, etc.
E.	9	Electric equipment and supplies
P.L.	10	Plumbing supplies.
P.F.	11	Pipe and fittings
M.T.	12	Miscellaneous tools and machinery
M.S.	13	Miscellaneous supplies
O.S.	14	Office supplies
C.K.	15	Camp and kitchen ware
E.I.	16	Engineering instruments
F.P.	17	Fire-protection equipment
C.	18	Cranes
L.B.	19	Lumber
R.F.	20	Rails and fittings

Clerks at each shipping point numbered consecutively the consignments for Vancouver, and filled in a shipping tag for each. On these tags were entered quantities, sizes and the general classification numbers of all items included in the consignment. These shipping tags were checked on arrival at Vancouver, and a more complete record was made for the catalog files. The first or general record was made in duplicate on 4 x 8-in. cards, as shown in the accompanying illustration. A yellow copy was sent to Portland headquarters, while a salmon-colored copy was kept at Vancouver barracks. The entries on these cards give the classification number and indicate the storage location by warehouse and section numbers. The inventory number shows by letter the general classification of the article and the number of the item, as entered in that classification. The shipping number includes a letter to designate the camp from which the item came, and the number of the shipment from that camp.

INVENTORY NO.	REQ. NO.	COST PRICE	APPRAISED PRICE	TOTAL NO.	ITEM AND DESCRIPTION CLASS NO. 3	WAREHOUSE LOCATION GENERAL	WAREHOUSE LOCATION STATION	PAGE NO. 4 SECTION 3 REMARKS
L 212	1253 R	$8417.00	$6850.00	1	12½ x 12 Tacoma Yarder-extended fire box with loading drum and shipping skids. Engine No. 1451	Sgar	S-5	90% 1500'-1 3/8" Cable 2500'- 5/8" Cable 2000'- 3/8" Cable on drums For specifications See supplement page 48 class AA

COMPLETE CATALOG LOOSE-LEAF FILE SHEET USED AT VANCOUVER BARRACKS

The catalog files, on the other hand, contain a more detailed description, as shown, and where possible refer to specifications or other manufacturer's records. These catalog files, of which five copies are made, carry the same inventory number as the card index, thus providing a ready cross-index.

A policy was established of putting the current market price on new goods, and rating used equipment on a percentage of this price. To arrive at a fair appraisal value of used equipment such as cranes, locomotives and logging engines, a thorough examination was made, usually by three inspectors working together. One of these represented the catalog board, another the sales department, while the third was a civilian engineer employed as an independent. These three men looked over the equipment together and discussed and agreed upon a fair price for each engine before moving on to the next. Only the clothing and grocery stocks, being considered more or less perishable, were turned over to brokers. On all other classes the purchaser may deal direct with the Spruce Division officers, no matter how small the purchase.

Logging Engine — "Tacoma Yarder" # 1451, 12½ X 12--- 3 Drums, Extension fire box, Puget Sound Iron Works — Used. CLASS 3

INVENTORY NO.	SHIPPING NO.	NO. ARTICLES	PURCHASE NO.	REQ NO.	PRICE	VALUE
L-212	Y 1096	1	1253-R	19	8417.00	90%

GENERAL-RECORD CARD FOR ALL EQUIPMENT RECEIVED

The classification and inventory work was assigned to a catalog board of Spruce Division officers appointed immediately after the armistice was signed. A sales board was also organized and charged with the advertisement and disposal of the property. As soon as the more important items could be classified a list was published, giving a month's notice that bids would be opened Feb. 15. Some 1500 bids were received, but in most of these the bidders had ignored the announcement that bids far below market values would not be considered. Therefore comparatively few bids could be accepted.

Equipment began to come in rapidly by Nov. 25, and the steady stream continued until about Feb. 1. A total of 1324 carloads was received. Without actually seeing the Vancouver storage yards it is difficult to visualize the great quantity and variety of equipment collected there. For example, there were 274 donkey engines, most of which were of large size (11 x 13- and 12 x 14-in. cylinders), 26 locomotives, equipment for three complete lumber mills, 260 pairs of car trucks, a million-dollar stock of groceries, 11,700 tons of rails and 600 motors with electrical equipment complete. Absolutely nothing was left in the woods. Even scrap was brought in to avoid the possible criticisms that might be aroused should it be found there in later years.

Much of the equipment was loaded in the rain, and all of it was more or less hastily taken down, so that, as it arrived at Vancouver, each consignment received such attention as it required. Wet tents were dried out in the kilns; broken parts on machines were replaced; gears and moving parts were greased, and bright parts were coated with white lead. To prevent rusting of the machine as a whole, most of the larger pieces, such as cranes, donkey engines and car trucks, received a light coat of black paint.

At first, logging engines were stored on their sleds, just as they came in. These sleds are made of large timbers about 60 ft. long, and had to be placed parallel to the spur tracks between which they were stored. This required so much space that it was decided to dismount the engines and pile the sleds. The engines were then set on cribs of railroad ties built up to flat-car height, as shown, so they could be easily loaded or unloaded over skids.

The steel cable required more attention at Vancouver, perhaps, than any other one item on the lists. Up to Apr. 15 a total of 629,678 ft. of it had been received in sizes of ⅜ to 1¼ in. All of this except the unused reels was rewound so it could be measured, oiled, inspected and appraised. To facilitate this work, two frames, on which reels could be conveniently turned by hand, were set up in the cable warehouse, about 50 ft. apart. A long, narrow trough, from frame to frame, was filled with crude oil, and a snatch block at either end oiled the cable as it passed from reel to reel.

LOGGING ENGINES DISMOUNTED ON TIMBER CRIBS

After being rewound, the cable length was marked on each reel, and the appraised value was entered on the records. Cable was unwound from engine drums in the yard by use of a locomotive crane. To save rewinding this cable again in the warehouse, it was drawn over a measured length of track by means of a snatch block attached to the rail. Thus it passed under the inspector's eye and through a small oil tank on the crane tender, so that when delivered to the warehouse the cable had been oiled, measured and appraised and its length had been marked on the reel.

On the 13 railroads built last year by the Spruce Division nine were considered to have no future as commercial logging projects; therefore, their equipment and rails were brought to Vancouver. The Lewis and Clark line was taken over by the lumbering company with which an agreement on this point had been made before construction. The other three lines are being offered for sale complete as commercial logging properties. These include the 36-mile line on the Olympic peninsula in Washington (Railroad No. 1), 40 miles of track on the Yaquina lines (Railroads Nos. 10, 11 & 12) along the Oregon Coast and the North Nemah line (Railroad No. 5) 7¾ miles long near Willapa Bay, Washington.

A total of 143,000,000 ft. of airplane stock was shipped out by the Spruce Division, the rate of production having been increased from something over 2,000,000 ft. per month in October, 1917, to about 22,000,000 ft. in October, 1918. The 29,000,000 ft. of commercial lumber stored at Vancouver has been sold. All told, about $10,000,000 worth of equipment was centralized at Vancouver Barracks; about $2,000,000 worth of this has already been disposed of.

Shortly before the signing of the armistice the production activities of the Spruce Production Division were taken over by the United States Spruce Production Corporation, and the personnel of the latter has been reduced steadily since that time. Those who remain in important positions are those who were identified with and are proud of its war-time activities. Some are still in the service and some are retained in a civil capacity. The War Department desires that the corporation liquidate its own affairs, and this is being done under the direction of Lieut. Col. C. P. Stearns as successor to General Disque. The fixed policy of the corporation is "to go out of business with as little disruption as possible in the industries and business of the Northwest, with the hope that when the corporation and its activities have passed into history it may be said of it that it helped rather than hindered the community in which it operated."

Motor Sweepers and Trucks Show Economy

HAULAGE of street material by motor trucks, and operation of motor-driven street sweepers and sprinklers have proved economical in Denver, Colo., according to a statement made by F. J. Altvater, highway commissioner, in the April number of *Municipal Facts*, published by the city. At the present charge for teams, the trucks hauling slag and gravel will pay for themselves in one year.

Motor trucks for hauling slag and gravel for street work show a material saving in cost, owing to the high prices and slow work with teams. In 1918, the daily cost for a team was $6 per day, which this year has been increased to $7. A team will average three 1½-cu.yd. loads per day, making a cost of $1.33 per yard or $1.55 at the 1919 rate. Last year three motor trucks hauled from 5540 to 5930 cu.yd. each at an average cost of $0.766 per yard. This cost included repair, oil, gasoline, chauffeur, interest at 6% and depreciation. The depreciation charge was computed at 33.3% for the first year and 25, 20, 15 and 6.3% for succeeding years. Five motor-driven street-sweepers and a motor-driven flushing machine also effected a considerable saving over horse-drawn apparatus; but the sweepers were rather light for the service and their repair cost was very high. Two 2-ton trucks were purchased later to do the heavier sweeping, and as they are separate from the sweepers they can be attached to wagons and other apparatus and thus are kept in use for about 16 hours daily. The two new machines have displaced 10 teams.

Construction Firm Finds Personnel Work Profitable

Group Insurance, Shareholding, Accident Prevention and Medical Care Repaid By Increased Efficiency

(Editorial Interview)

ACCIDENT prevention is an important part, but it is only a part, of the "personnel" service which contractors owe their employees. If reduction of accidents in construction operations pays (and it certainly does pay) so do group insurance, medical supervision and social and personal service of many sorts. Combine these activities with some arrangement by which directing employees become shareholders in the firm's business, and an organization is knit together with which a contractor can face unstable construction conditions with reasonable assurance. "These assertions are not theory," stated L. D. Woedke, manager of the protection and safety department of Fred T. Ley & Co., contractors; "they are facts demonstrated by our own experience."

About every kind of construction has been performed by the company, its work has been widely distributed and its force on different jobs has averaged from ten to ten thousand. If personnel work is impracticable in contracting it would seem that it should fail under these conditions. But the company has proved to its own satisfaction and to that of its clients and its employees that it can take so good care of its men that "they follow the company's operations everywhere and repay, in efficiency, loyalty, reduction in labor turnover, economy and speed, every dollar spent in their interests."

Accident prevention as it is practised by the firm has already been described in *Engineering News-Record* of Mar. 14, 1918, p. 523, and all that need be said in addition is that the results become more favorable with increased experience. Medical service goes beyond caring for injuries. On large jobs complete field hospitals are installed and equipped with medical and surgical supplies, and a regular staff of doctors and nurses and attendants is placed in charge. All kinds of illness are treated in these hospitals, not merely injuries received on the job.

As an illustration of this policy, when influenza threatened to overcrowd the regular hospital accommodations on one job last autumn, an additional field hospital with 40 beds was built and placed in service, with doctors and nurses, in 12 hours. When work on this hospital was begun mechanics and laborers were packing their kits for a general exodus. The sight of the new hospital at once relieved the crisis. Grips were unpacked, the panic subsided and not a man left the job.

The establishment of hospitals is not practicable on small operations, but no job is too small to be without a first-aid cabinet. If the work is near a settlement where physicians are available, arangements are made whereby they will be on call if needed.

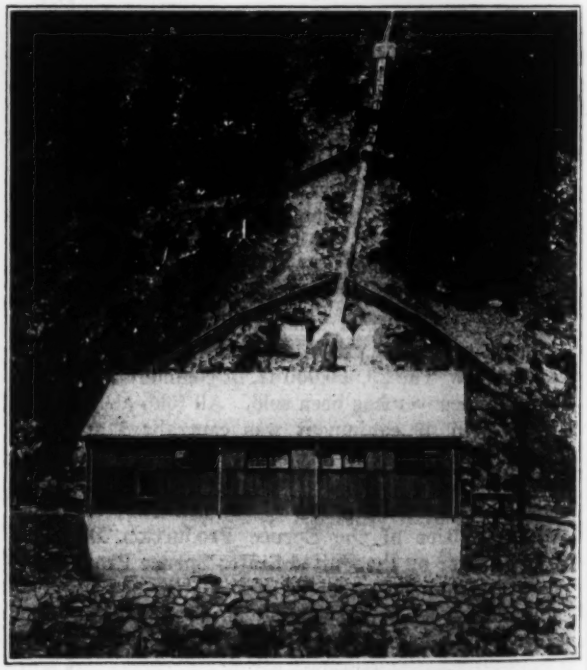
Good wishes and prudent advice are not the limit of service toward making employees financially independent. The firm gives its permanent or regular employees life insurance in amounts of $1000, $1500 and $2000, depending on length of service. In addition, these permanent employees, department heads, superintendents, engineers, etc., have, during the last few years, received preferred stock in amounts determined by length of service, position held and record for good service. A record in detail of every employee enables the firm to shift men to better positions and to place employees who have finished or are about to finish their work on various operations. All these measures combine to make the employee feel that he is an integral part of the business, and he repays the company by loyalty and better work.

The employees themselves have organized for mutual service. The Leyers Club at the home office has branches on all large jobs. Through the activities of this club athletics, dances, field days, lectures, etc., are fostered, the sick are visited, and assistance is given to anyone in trouble. Weekly news bulletins edited by the club are issued to all jobs, offices and departments. The club is now considering a sick-benefit and relief plan.

Annually the company gathers at the home office in Springfield, Mass., all its superintendents, foremen, timekeepers, engineers, department heads, office managers and executives, for a discussion of all phases and details of the business. At this time all complaints, difficulties or troubles of the respective departments or field offices are discussed, with Mr. Ley sitting as chairman. Full stenographic reports are made of these meetings. From the various discussions changes in policies, rules, instructions and agreements have resulted, with improvements in organization and in methods of doing work. All in all, the interest the company has shown in its men has been a substantial factor in the company's rapid and substantial development. C. S. H.

Timber Walls to Divert Rolling Rock From Power House

IN THE cañon of the Tuolumne River, where water will enter an 18-mile tunnel on the Hetch Hetchy project, the slopes are quite steep, with a cliff here and there. Early in the construction work a small wooden tool house near the site of the temporary power house



POWER HOUSE WITH PROTECTION OF TIMBER WALLS

was practically demolished by a rock which was loosened by the road excavation above and rolled down the hill. This accident was taken as a warning of possible damage that might result if a boulder rolled down onto the roof of the temporary power house. Timber wing walls were therefore built along the penstock for the purpose of stopping or diverting rocks that might roll toward the power house.

The power is supplied by a 42-in. steel pipe, 530 ft. long, running from the end of the ditch line on the hillside above. Each of the wing walls consists of two parts flanking the penstock at an angle above the power house. The supports are 14 to 20-in. round posts set 8 ft. in the ground. On the uphill side of the posts a facing of rough logs has been built up and lashed to them with pieces of old cable. Thus far the power house has sustained no damage from rolling rock.

This work is being carried out by the City of San Francisco under the direction of M. M. O'Shaughnessy, city engineer.

Economics of Transportation in the Mississippi Valley

Southern Ports Can Well Be Developed to Take Care of Some of Our Foreign Trade if Interior Transportation Is Revised and Improved—Existing Rates Limit Interior Zones for Foreign Shipment

By J. R. Bibbins
Engineer, Associated with Bion J. Arnold, Chicago

TRANSPORTATION economics in the United States today has to be considered in relation not only to domestic trade but to foreign trade. Future development must take into account easy and cheap transport of goods to and from the great interior of this country to the centers of production and consumption the world over. No longer should it be proper, in the planning for trade, to be bound by the great East-West railroad lines, built up in the past by readily seen causes, but the strategic and economic position of the Mississippi Valley should be studied with a view to its logical connection to world routes. A start on such a study has been made. Its elements indicate some radical revisions in the transportation routes and methods of the United States.

A physical examination of the Mississippi drainage basin leads one to wonder why the lines of economic gravitation cannot be developed along the same lines as hydraulic flow, and then to inquire what forces and tendencies so altered this natural gravitation in the early history of the United States as to result today in the elevation, over the passes of the Appalachian range to north Atlantic tidewater, of by far the greatest proportion of the production of this valley, with all the increased expense incident to such elevation. No student can overlook for one moment the fact that the urge of commerce originated in Europe and has continued in effect throughout the century-old commercial independence of America. However, it must be patent that the study of the "vector diagram" of commerce with reference to Europe and South America, respectively, will reveal the fact that the relative value of abscissa and ordinate are changing, with the result that the force of commerce is gradually shifting toward Panama. New Orleans and Galveston have grown as southern gateways of the United States largely by virtue of the fact that other nations needed our cotton. New Orleans has profited by a triangular trade to Europe, to South America, and back to New Orleans in British bottoms. But still the great transcontinental gateways of Chicago, St. Louis, Pittsburgh, etc., have witnessed the overflowing production from the vast Western plain headed for north Atlantic ports directly in contravention of the natural outlet for this territory through the southern water gates.

The answer must lie in the brains of the inhabitants of the Mississippi Valley, who represent the majority of the voting population of the United States. Their vast waterways lie idle. While dozens of freight trunks radiate from the crowded East-West tunnels of Chicago and St. Louis, not one radial trunk reaches into the Northwest from the second port of the United States. The country seemingly has been educated to think east and west, and the prevailing rate system is conceived on its east and west economic base line. What will be the result when the people of the Mississippi Valley fully conceive of a different economic base line—Chicago to the Gulf?

The Mississippi Valley Association, recently convened in Chicago, showed itself to be alive to the necessities of this situation. At this convention standing committees reported upon numerous matters of fundamental importance. One of these committees, a subcommittee on the economic development of waterways, terminals and electric and highway feeders in relation to transportation, presented a report prepared by Bion J. Arnold, consulting engineer, Chicago. Colonel Arnold's report was based on instructions to investigate the now existing facilities for foreign trade; that is, the existing physical plan of the railroads, terminals and steamship lines and their capacity and adequacy for the contemplated freight movement of the valley. It also dealt with the economic policy under which these transportation facilities are used and should be used.

As a preliminary to the study, Colonel Arnold prepared a statement of principles and policies which is as follows:

1. Methods of securing actual commodity movement along natural economic lines of transit.
2. What are these natural economic lines of transit?
3. Natural and artificial barriers, preventing logical movement.
4. Necessity of curtailing man-handling of freight.
5. Economic median lines of rail transit for overseas movements.
6. Function of low-grade lines in controlling mass movement; their ultimate dependence on shipping.
7. Midcontinental gateways and their effect on commodity movement.
8. Shall the cost-of-service-plus-profit basis be allowed to control the transit movement in the valley?
9. Should overseas traffic movement be adjusted to a least-ton mileage basis—that is, shortest route, taking the relative cost of water and rail into consideration?
10. Function of storage in absorbing heavy seasonal movement and securing much desired two-way loading for steamship lines—i.e., a "balanced port."

11. Effect of policy of national waterway development upon transcontinental movement.

12. Lessons to be drawn from past waterway experience.

13. Proper economic field for railroads and waterways with respect to different classes of freight.

14. Comparative possibilities of Mississippi River and rail routes between specific points.

15. Should waterways develop as through freight carriers —i.e., largely as a full-cargo trunk line, rather than as packet lines?

16. Special terminal facilities required for: (a) Freight originating at main terminal; (b) transshipped freight.

17. Desirability of the "sailing day plan" as a terminal policy for both rail and barge lines.

18. Type of floating equipment and economic units best suited for handling different classes of cargo.

19. Can the electric railways function individually or collectively to any extent as freight carriers to and from points of rail interchange or transshipment to water lines?

20. Is there any necessity of extensive motor-highway development as a means of accelerating interior production and thus tending to guide this movement through properly designed channels or terminals?

21. Immediate steps to be taken to secure a sound development program.

General Consideration of Principles

Having put these general questions, Colonel Arnold continued with the following general consideration of the policy to be pursued and the conclusions which are to be drawn therefrom:

The Mississippi Valley should be considered as a great *drainage basin* favoring natural rather than artificial outlets. Up to the present time, the laws of economic gravitation within this drainage basin have been artificially upset to a large degree. The question now is to reëstablish economic equilibrium, which involves four essential elements: (1) Rails; (2) waterways; (3) terminals, and (4) shipping.

It is contended that commerce needs *both* rail and inland water transportation, especially where a vast bulk of commodity movement runs in seasons. Railroads are expensive transportation systems when they have to be built largely for short-seasonal use. Therefore, on general principles, the capacity of the natural waterways should be drawn upon to their fullest extent where possible to relieve railroad operation of this expensive peak-load traffic.

Successful business adjusts the character of its facilities to the requirements and profits of each particular branch; that is, classifies its operation. So should the waterways be used intelligently as a coördinate agency to railroad transportation, rather than as a competitive agency.

But a clear definition and understanding of advantages and limitations is very desirable. To attempt to handle bulk cargo in little bottoms with no terminal facilities is manifestly wrong policy. The great waterways are trunk lines primarily, and transportation should be provided and sold *wholesale* rather than retail. Further, something more than a paved levee or even a simple wharf is required for economic handling, especially with rising wages. Frequent *man-handling* will destroy both the profits and the practical success of waterways movement. For this reason, the "*original-package*" idea is being actively worked out, by means of which transshipment from rail to barge and vice versa may take place, without breaking bulk, through mechanical handling in original packages.

Over 30% of Chicago's freight passes *through* the city, carload freight being rehandled in original cars, less-than-carload freight being handled in parcels. For carload freight, man-handling has been reduced to a minimum by the terminal yards at clearing. The railroads are still wrestling with the problem of reducing the cost of man-handling less-than-carload freight.

In the Mississippi Valley's largest port, nearly 30% of the incoming freight passes over the wharves *direct* and this would probably be increased to 50% if all *freight held in transit* were included; i.e., seasonal freight held over season in storage warehouses for later transshipment. Chicago's freight has to pass on promptly, as every hour's delay means increased congestion. Overseas freight, on the other hand, must have waiting time, hence the vital importance of warehousing, storage and methods of prompt handling to clear the wharves for incoming and outgoing boats. It would be idle to build railroads without vast city terminals. It is equally idle to develop waterways without equivalent terminals; for terminals are only reservoirs in which to permit freight to "slow up" in its general movement to destination. The faster the main-line movement, the more terminal capacity is required to avoid congestion.

Conclusions as to Policy

In order that the Mississippi Valley Association may have a tangible basis upon which to organize, promote and finance the advanced policies, physical improvements and desired changes in established methods of transportation, it should undertake a transportation survey to be conducted with as little delay as possible for the purpose of argument and defense of the following program:

1. Encourage the construction of more direct trunk-line transportation from the Northwest to Gulf ports, particularly via the Alexandria-Shreveport gateway.

2. Ascertain the maximum possibilities of classification and freight handling by means of which slow and fast freight may be routed on lines best adapted thereto, with rates gaged accordingly.

3. Endeavor to secure a freer interchange between steam and electric lines than at present, in order that the latter may become more useful in the general transportation scheme than at present.

4. Consider fully the economics of motor-truck transportation in all its aspects, prior to commitments for vast expenditures in expensive motor highways, so that both motor equipment and highway expenditures may be kept within their proper economic limits.

5. Study carefully every possible means of encouraging a balanced two-way vessel movement through Gulf ports which will be perhaps the most important factor in attracting additional shipping facilites.

6. Support the Government program for inland waterway development assisted by state contributions where necessary to prevent excessive lockage time and delays on canalized routes.

7. Ascertain the reasonable *base cost of service* per ton-mile of transportation within the valley:

(a) By rail;
(b) By water;
(c) By rail and water;
(d) Cost of transshipment:
(1) By handling or trucking,
(2) By mechanical means
for typical commodities and points of origin.

8. Ascertain similar base cost of service per ton-mile of both waterway and overseas haul, disregarding existing arbitraries and differentials.

9. Determine how far the cost-of-service-plus-profit basis may be allowed to control the transit movement within the valley, without too great disturbance of the existing economic structure upon which the commerce of the country is based.

10. Determine what readjustment of shipping schedules and capacity, as between various ports, is reasonably called for in order to meet this cost-of-service basis of interior transit.

11. Ascertain the desirable economic section which should be built for the Illinois waterway, the rock cuts and for locks in this and in other waterways, in order to minimize the delays in breaking up fleets of barges in transit.

12. Consider with care the economic size of barge units.

13. Consider the maximum application of the "original-package" idea for rail-river transportation, in order that a fair trial may be had.

14. Encourage the construction of barge terminals for originating or transshipped freight, and especially the pro-

vision of mechanical methods of freight handling to the maximum extent.

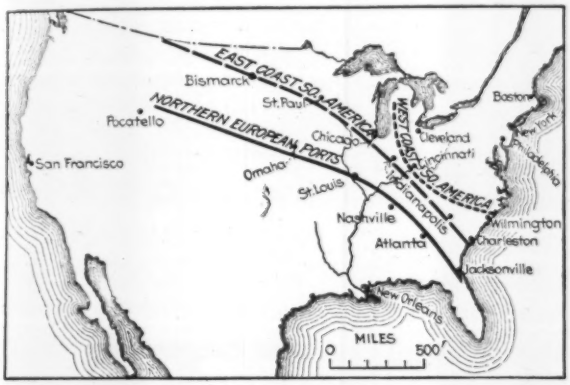
15. Impress upon municipalities the vital necessity of doing their full share in providing the required terminal facilities.

Delays in transit will be the greatest enemy of inland water transportation.

Economic Median Lines Explained

A definite conception of what is involved in the great economic questions analyzed in the foregoing statement is illustrated in the accompanying diagram, which is presented through the courtesy of the Public Belt R. R. of New Orleans, being a part of a technical study of the transportation development of that city.

This diagram shows which territory is properly tributary to the Gulf and North Atlantic ports of the United States (specifically in the diagram New Orleans and New York), disregarding all other considerations except those of rail and overseas transportation. The territory north and east of each of the lines, for instance, should



ECONOMIC MEDIAN LINES SHOW ZONES FROM WHICH OVERSEAS FREIGHT SHOULD BE SHIPPED

Goods to and from territory north and east of lines should pass through New York; zones south and west are tributary to New Orleans; based on average prevailing tariffs, assuming one mile rail haul equals four miles water haul.

ship goods to the foreign districts attached to those lines, through the north Atlantic ports. The territory south and west of each of the lines should ship and receive goods through the Gulf ports. These lines, which for the purpose are called economic media lines, are worked out on the only basis now available; that is, cost-of-service-plus-profit average rail haul in the United States and average water haul overseas with such controlling rate points as Gibraltar, Pernambuco and Panama. In other words, these lines reflect what the rail and water carriers actually charged to the shippers for transportation.

Considering Panama as the water-gate to the Pacific and the west coast of South America, it will be seen that almost the entire Mississippi Valley is logically tributary to Gulf ports. For the east coast of South America and South Africa, the Chicago gateway marks in general the dividing line between Gulf and Atlantic ports. If we consider northern European ports, it appears that almost half of the Mississippi Valley should in fact be tributary to the Gulf ports.

Is this allocation carried out in practice, even under present rates? The answer will be found partly in the great preponderance of east-west transportation lines, incidentally in the comparative absence of the trunk lines from the mouth of the Mississippi into the great Northwest.

It may be contended that these lines are not properly conceived, as they must be drawn for specific cases. Theoretically, this is quite true, and yet the diagram illustrates forcefully the general situation. It is fundamentally based upon the assumption of one-mile rail-haul equals four miles of water-haul. Considering the fact that transcontinental rates are constructed upon a New York-Chicago base line with its extensive detours or mountain climbs, it is plain that if such a diagram were reconstructed on the basis of a water-grade base line of Chicago to the Gulf, all three median lines would move eastwardly, and the result would be still more conclusively in favor of the development of Mississippi Valley transit through the Gulf ports.

In view of these conditions, should not the United States of America, with the largest systems of transportation on the face of the globe, awaken to the necessity of a deeper consideration of this vital subject of internal transportation and lift this question out of the domain of legal and political controversy, and place it squarely upon the basis of scientific analysis and uncontrovertible fact—so that uncoördinated state legislation and ill considered action by both labor and Congress may not culminate in retarding rather than developing this great agency of transportation, which has been chiefly instrumental in the development of our commerce as it is today?

Water-Softening Sludge Repumped Eliminates After-Reactions

THE re-use of sludge in the lime softening of water at Grand Rapids, Mich., to intensify the removal of colloids, to save alum and accelerate the "curing" of water so as to stabilize the effluent, thereby eliminating after-reaction difficulties, has been tried in a large-scale experiment. The results were told recently by W. A. Sperry, chemist in charge, in a paper read before the Illinois Section of the American Water-Works Association. The experiment was suggested by what is being done with the use of air and sludge in the treatment of sewage.

Preliminary laboratory experiments indicated that the time of contact was not a factor beyond the period required for thorough intermixing; that the volume was of exceeding importance; that the sludge was most effective when applied just after the addition of alum or when the normal lime reactions were most nearly completed; that it seemed most effective in removing the products of the reaction rather than to hasten it; and that it worked better under winter conditions than under summer conditions. The amount of air applied was such as to keep the sludge well up in suspension, with the result that it formed into large, ragged, feathery flocs that seemed to fall from suspension like sand.

For the working-scale experiment a motor-driven, 6-in. centrifugal pump was connected with a 100-ft. section of pipe with 1-in. holes bored 1 ft. apart on alternate sides of the horizontal diameter. This pipe was located at a point in the settling basin where the sludge accumulated deepest.

The several runs confirmed the laboratory tests as to the greater effectiveness in the winter and the importance of a sufficient volume. Alkalinity was reduced

to 33 ppm., 10 parts lower than the average for five years. A negligible drop in alkalinity and normal carbonate was noted in the going through the filters. Ordinarily, the loss, causing incrustation, was 13 parts in alkalinity and 11 in normal carbonate.

The unfavorable considerations were: (1) Difficulty in getting a sufficient amount of sludge, due to the fact that it would not flow, and (2) the production of a finely divided suspended matter difficult and expensive to remove by alum. To eliminate the first difficulty Mr. Sperry suggests the use of a Dorr thickener to bring the sludge to the suction, or some type of traveling or flexible suction to follow up the sludge. The second difficulty was contrary to the laboratory experiment and hard to explain, unless due to mechanical agitation in the pump. No agitation was used other than that afforded by the normal baffling. As an explanation of the results, which Mr. Sperry considers of enough value to warrant further study, he stated that they are largely mechanical in that the sludge contains no residual chemical activity but apparently acts to "scour out" the colloidal matter, the many crystals of calcium carbonate acting as foci for the more rapid formation of such crystals than normally takes place.

Details of the Failure of a 90-Foot Molasses Tank

Steel Shell Used in Wrecked Boston Structure Highly Overstressed—Designed and Built by Construction Company

By Burtis S. Brown
Consulting Engineer, Boston, Mass.

THE peculiar accident of serious magnitude which occurred in Boston during the noon hour, Jan. 15, as described in a news note in *Engineering News-Record* of Feb. 13, 1919, p. 353, was the result of the collapse of a 90-ft. riveted steel tank used for storing molasses by the Purity Distilling Co., a subsidiary of the United States Industrial Alcohol Co. A flood of 2,300,000 gal. of molasses spread over Commercial St. and the adjoining lots, and filled the cellars of nearby houses. The steel plates of the tank wrapped themselves around the columns of the elevated-railway structure, shearing one of them completely near its base.

This tank, 90 ft. in diameter and about 50 ft. high, was built in 1915-16. The treasurer of the distilling company accepted a noncompetitive bid from the Hammond Iron Works, a construction company which had built smaller tanks in Cambridge for the same company.

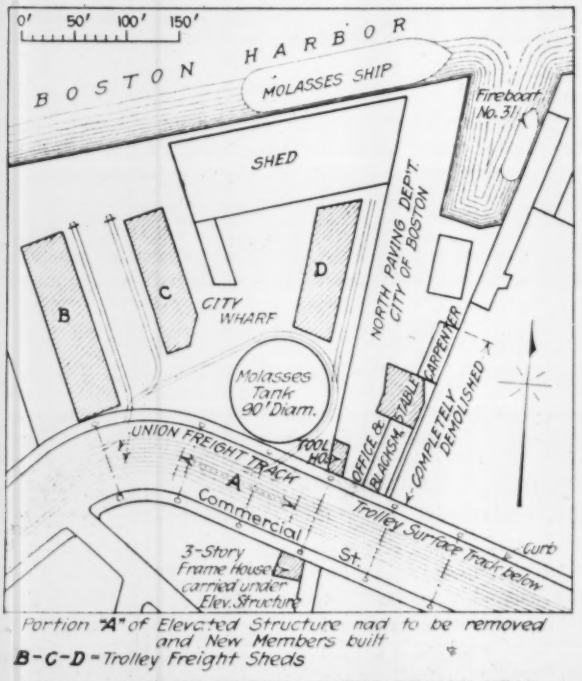


FIG. 1. LAYOUT OF DEVASTATED REGION NEAR MOLASSES TANK

It "was thought" that a factor of safety of 3 was used. Details were left to the construction company, and the tank was formally accepted by the purchasers on Feb. 1, 1916, and put into use for storing molasses.

The court finding, announced after investigation, that this tank design was wholly insufficient in structural strength, is borne out by stress computations submitted herewith, showing a highly overstressed condition of the steel shell and rivets. Among other causes which have been suggested are: (1) An explosion; (2) a collision by a trolley freight car—it is reported that

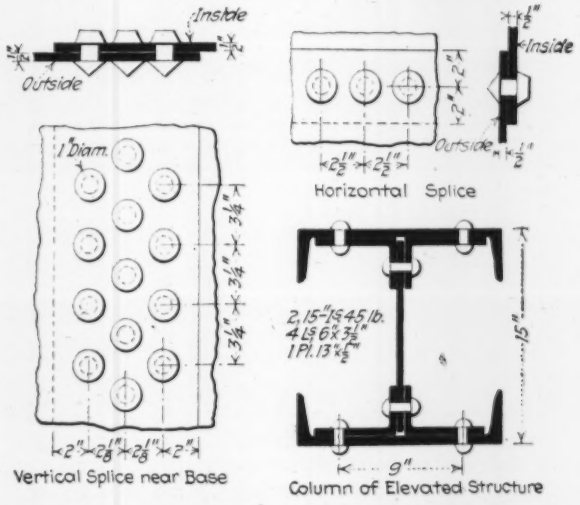


FIG. 2. RIVETED JOINTS OF TANK AND SECTION OF ELEVATED COLUMNS

twice before such cars had split a switch and run into the tank; (3) vibrations from elevated trains. The day of the accident was cloudy, the wind was blowing from the west about 13 miles per hour, and the temperature was 44° Fahrenheit.

Location—The accompanying plan (Fig. 1) shows the surrounding buildings before the collapse; the tank, located on Commercial St., adjoined the North End playground and recreation pier and other buildings belonging to the City of Boston, including the headquarters of Fire Boat No. 31, and the office, stable and storage yard of the North End division of the paving department. To the west are the trolley freight yard and sheds on land owned by the Boston Elevated Railway Company.

The tank was about 300 ft. from the harbor line, and molasses was brought by steamers and pumped into it for storage. Thence it was drawn into trolley tank cars and transported to the Cambridge plant of the distilling company and used to make alcohol for the

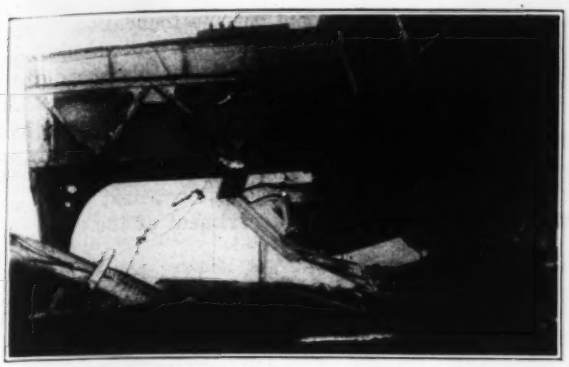


FIG. 3. ELEVATED-RAILWAY COLUMN SHEARED OFF NEAR BASE AND BENT UP UNDER GIRDERS

manufacture of munitions. The Boston Navy Yard is located just across the harbor.

Results of the Accident—Twelve persons lost their lives either by drowning in molasses, smothering, or by wreckage. Forty more were injured. Many horses belonging to the paving department were drowned, and others had to be shot. The elevated structure of the Boston Elevated Railway Co. was put out of use for several weeks. Occupied houses were demolished. Motor trucks passing along Commercial St. were marooned and in some cases the truck bodies were floated away several hundred feet, and in general the vicinity looked as if a small cyclone had struck the place.

Calculations—The weight of molasses is taken as 11.75 lb. per gallon, or 90 lb. per cubic foot, which is 44% heavier than water. From data obtained just after the collapse, the depth of molasses in the tank was 48 ft. 10 in. The steel plates in this tank near the bottom, as measured by calipers, varied from ½ in. to ⅝ in. in thickness. Ordinary lap joints were used. The rivets were of 1-in. diameter, with flat-topped heads on the inside and conical heads on the outside. The tension in the side of the tank at the bottom

FIG. 4. VIEW OF WRECKAGE, SHOWING ROOF AND BASE OF COLLAPSED TANK

would therefore be $90 \times 48.83 \times 90/2 = 198{,}000$ lb. in 1-ft. height. Hence the unit stress on a solid ½-in. plate, $12 \times \frac{1}{2} = 6$ sq.in., is 36,000 lb. per square inch, or on ⅝-in. plate, $12 \times \frac{5}{8} = 7.5$ sq.in., is 26,400 lb. per square inch. If the riveted-joint efficiency is assumed to be 66%, the unit stress on the net section would be 50,000 and 40,000 lb. per square inch, respectively. These values approach the ultimate strength of steel plates.

The spacing of the rivets in the vertical joints near the base is shown in Fig. 2. There are 11 rivets in 1-ft. height, so that each rivet carries 198,000 lb. ÷ 11 = 18,000 lb. Comparing this value with the allowable stresses for 1-in. rivets bearing on ½-in. plates permitted by the Boston building law (10,000 lb. per square inch shear and 18,000 lb. per square inch bearing) it is found that the rivets are overstressed about 2.2 times in shear and 1.92 times in bearing.

An examination of the wreckage shows that part of the vertical joints failed by shearing off the rivets, while at other points the plates were torn apart between rivets. Many of the rivets dropped out of the holes after shearing off, indicating that possibly the rivets were driven cold.

Effect on the Elevated Structure—On collapsing, a side of the tank was carried against one of the columns

FIG. 5. STEEL SHELL AND ELEVATED RAILWAY WRECKED

supporting the elevated structure. This column was completely sheared off as shown in Fig. 3, and forced back under the structure. These columns are built up, as shown in section, Fig. 2, and are spaced between 50 and 60 ft. apart longitudinally at this point, where the structure is on a curve. Fig. 5 shows how the track was pushed out of alignment and the superstructure dropped several feet. It has been necessary to remove completely two entire bents, as noted on the plan, where the collapsing side of the tank was carried against the outer face of the curve.

The tank was built on a concrete mat, supported by concrete piles. After the débris was cleared away, the concrete appeared to be in excellent condition. Not a crack or defect of any kind could be noted anywhere.

Approval of Plans—The plans for this structure

FIG. 6. STEEL PLATES WRAPPED AROUND COLUMN

were filed Sept. 30, 1915, with the Boston building department, as required by law, and after the examination by the plan division a permit was issued. The plan examiner who was supposed to check the plans admitted in the municipal court investigation that the problem was beyond him. He approved the plans as filed for construction because they bore the stamp of C. H. Gannett, a civil engineer, who filed the plans for the distillery company. The latter did not check over the steel design, but simply laid out the foundations. The building department now requires that all calculations of the designer shall be filed with the plans and that the sheet be signed.

From the foregoing investigation it would appear that this tank was erected near a busy city street, where hundreds of lives were endangered, with practically no factor of safety and without competent check of the design by the building department of the city.

Macadam Stone Treated With Deliquescent Salts

Roads at Detroit Naval Training Station Surfaced With This Material Have Noiseless and Dustless Surface

By Harlan H. Edwards
Highway Engineer, Chicago, Illinois

During the past few years a new type of macadam road surfacing has been developed in and near Detroit, Mich., and its use is spreading to other parts of the country as road engineers and municipal officials become acquainted with its merits. It is a combination of crushed stone and deliquescent salts, the latter being used for their water-collecting and retaining feature. This type of road-surfacing material was used during the past summer at the River Rouge Naval Training Camp, Detroit, Mich., and because of its low cost, ease of construction and maintenance, noiselessness and dustlessness, it was placed on most of the roads. Since this work was done, it is reported that contracts have been let to put trial stretches in the road systems of Wayne and Ottawa Counties.

Character of the Material

The stone used is a dolomite or limestone which, before impregnation, is crushed and graded into a well-proportioned mixture, varying in size from ½ in. down. When treated and placed on the road it has the appearance of wet, coarse, limestone screenings, and packs down under the roller to a smooth, compact mass. The chemicals used—a mixture of calcium, magnesium, and other chlorides obtained as a byproduct from salt wells—supply a property, the lack of which has made the purely water-bound macadam road a failure for motor traffic. Heretofore the water bond has failed because it could not be kept uniform. This resulted in a road that was either too wet or too dry. If too wet, the road softened and cut; if too dry, it crushed, ground, and disintegrated. The wind completed the job by blowing off the fine cementing material, leaving the large, sharp stones exposed. The result was the raveling and rutting of the surface.

In this mixture, on the other hand, the deliquescent salts act as a stabilizer, maintaining approximately an even degree of dampness throughout the entire mass. They do not easily wash off, waste or evaporate, but gather moisture from the air, dew, rains, and from the soil below the roadbed. This keeps the surface constantly damp—making practically a dustless roadway having enough elasticity to prevent crushing of the surface even under heavy loads. There is just enough moisture, so that automobile tires serve as a *constructive* instead of a *destructive* medium. The tires have a tendency to pack and "iron out" the road, rather than to suck up the fine particles. It has been found necessary to maintain a thickness of 4 or 5 in. of surfacing in order to hold enough moisture to insure this condition.

Method of Construction

In the construction of the roads at the Detroit Naval Training Camp it was necessary first to provide a firm foundation upon which to place the surfacing material, for the soil was originally a marshy river deposit, subject to inundation each spring. It had been drained recently to permit construction work to begin on the camp, and at the start was of such a consistency that at times it took four horses to pull an empty wagon through it. This necessitated delivering the first building materials at the camp by water.

A base of from 6 to 12 in. of brickbats, slag and cinders was placed and rolled on all the roads originally laid out, and over this foundation most of the heavy hauling for the camp was done. This consisted of heavy motor-truck loads of crushed stone, cement, lumber, cast-iron pipe, etc. The surfacing mixture was then hauled from town, a distance of about six miles, in large trucks carrying from six to eight tons per load. It was spread upon the subgrade to such depth that, when struck off to the proper crown and rolled, a thickness of at least 4 in. would result. This required from 5 to 5½ in. of the loose material. Before this was placed, however, an earth shoulder was thrown up and tamped to the proper line and grade on each side of the road.

Traffic need not be shut off the roadway during the placing of the surfacing, except between the time when the final crown has been given by the templet and the time when the roller is applied. In fact, it is well if wagons do travel over the road, for they help consolidate the loose spots which may not be reached by the heavy wide wheels of the roller. If a roller cannot be obtained, this packing can be left entirely to the traffic, with the only added expense of a man with a rake to smooth out the wheel and hoof marks.

At this camp a 10-ton roller was used. The surface formed was hard, yet, if a depression occurred, that part of the road bed could be loosened easily with a stiff rake or pick, and new material could be added to bring it up to a level surface, and packed down again with a tamp or by traffic. About six to ten times over with the roller was usually sufficient for the original compaction.

In order to provide adequate subdrainage in part of

this soil, a 4- or 6-in. farm tile was laid about 1 ft. off the edge of the road, and to a depth of from 2 to 4 ft. The trench was backfilled partly with cinders, and the remainder with loose stone, brickbats, earth, etc., to permit the surface water to escape rapidly to the tile.

The organization was usually small, consisting of one man and a helper to set line and grade stakes from the engineer's offset stakes, two men to build up and pack the earth shoulders, three men to spread the surfacing material, two men to strike it off to the proper crown with a wooden templet and one foreman—a total of 10. With this organization some 400 to 600 lin.ft. of 12-ft. pavement, crowned 1½ in., can be laid in a day. One cubic yard of the material covered approximately 7 sq.yd. of finished road, costing in all about $1.25 per square yard. This was under war conditions and prices, and the long haul by truck raised the price considerably. Under normal conditions, with a good organization and the source of materials nearer at hand, this price should be reduced nearly one-half.

This impregnated stone road-surfacing has many advantages for medium traffic roads and residence streets, and for walks and drives in cemeteries, large estates, etc., where a permanent, noiseless, and medium-priced road is desired. It matters little how many times it is torn up and relaid, as it will always knit again. One man with a horse and wagon or a small truck and a stock pile of the material should be able to keep from 12 to 16 miles of 20 ft. roadway in perfect condition. It is claimed that a satisfactory road can be obtained from dolomite, gravel, slag or cinders treated with these deliquescent salts, the degree of excellence being in the order given.

Standard Precast Concrete Frames Make Up Flume Trestles

Sections Cast Along Line Put Together To Carry Conduit Over Gullies Up To 180 Feet Long and 36 Feet Deep

CONCRETE trestles, made up of standardized trapezoidal frames set one on top of the other in bents and tied together with longitudinal stringers grouted into place, have been built to carry the conduit of the San Dieguito Mutual Water Co. from the Lake Hodges reservoir in southern California. The five-mile conduit consists in the main of a concrete-lined canal, but over depressions up to 36 ft. in depth the line was carried in iron flume or siphon pipe on the trestles.

In all, 27 trestles were required, of which 23 carried open flume and four were used to carry the 42-in. reinforced-concrete siphons at the low point where there would have been danger to the pipe from floods. In the construction of all these trestles the precast method was adopted, partly because of the difficulty anticipated in handling and pouring concrete in small monolithic structures which would each be a separate job, and partly because of a serious labor shortage that existed when the work was planned. It was believed that the precast sections could be erected with a smaller crew than monolithic construction would require.

Although the trestles varied from 15 to 180 ft. in length and from a few feet to 36 ft. in height, the precast sections were standardized so that the upper units on all trestles were the same. All bent sections were 4 ft. in height, gradually increasing in width from the top downward. The only variation in design of the trestles was to replace the cross-ties used as supports for the open flumes with slabs on those trestles which were to carry the 42-in. siphons.

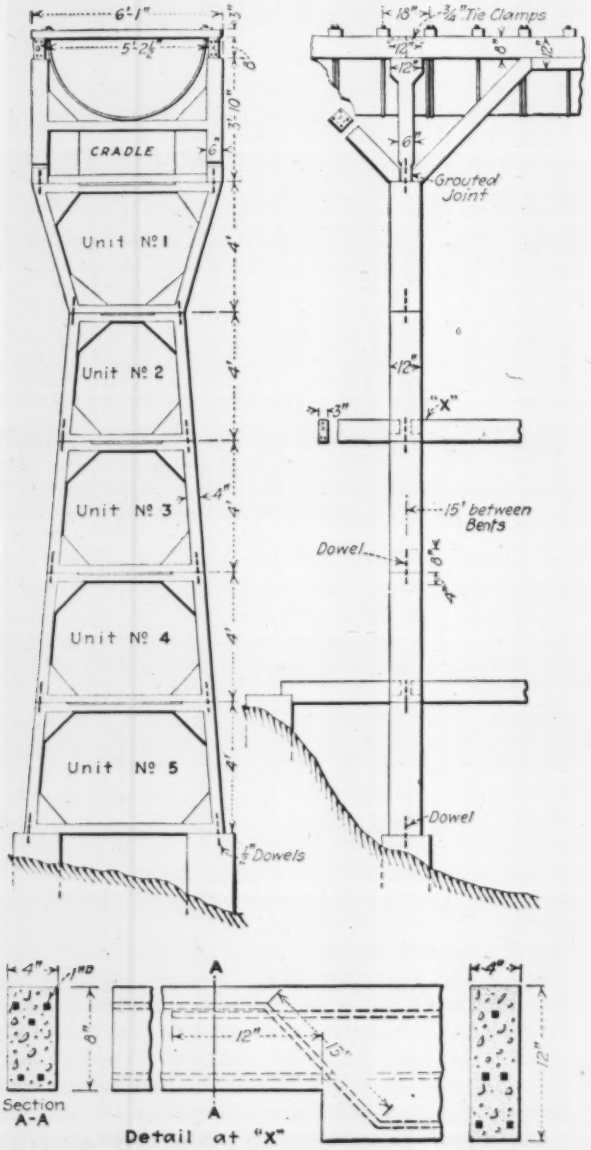
TRESTLES UP TO 36 FEET IN HEIGHT BUILT UP OF PRECAST CONCRETE FRAMES

The units forming the trestles were cast in nearby yards in forms laid flat. The forms were built up of 2-in. lumber surfaced on one side. By thoroughly scraping and oiling them between pourings, some were used 20 times. The method of procedure was to build first the forms required for the highest trestle on the line. There was then on hand a set of forms suitable for building any other trestle, and the bottom sections not needed after the larger trestles had been built were available for repairing other forms. Casting yards were located at points central to several trestle sites. Care was taken in placing the concrete around the steel, and it is believed that more accurate location of steel was obtained than would have been possible if monolithic construction had been used. After the concrete had been poured into the forms the top surface was finished by hand with a trowel.

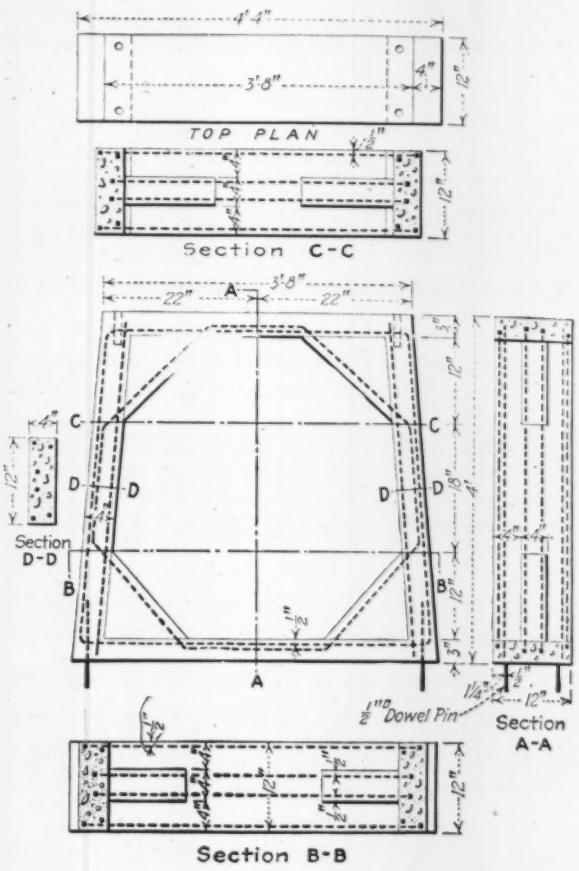
Cableways were used for the erection of the trestles

in all cases. The largest pieces to be handled were the girders for the siphon trestle which weighed about 1000 lb. each. In the higher trestles—the maximum being about 36 ft. from foundation to flume top—the sections placed at the footings weighed about 900 lb. Concrete piers were provided as foundation for each bent, and as each section was superimposed on its predecessor the dowel pins of ½-in. steel projecting 4 in. into the lower section were carefully grouted in place.

A feature of design is the dap used in the middle of the top of each section so that the sections bear one upon another only above the struts. This was done to avoid the possibility of any roughness on the surface at the center of the section causing a tendency to "rock." Even in the highest trestle the bents were erected independently and without guys. After the placing of the cradle on top of each bent the pair of girders connecting adjoining bents were placed, and the tie clamps were grouted into place to fasten together abutting girders.



DETAILS OF PRECAST PIECE TRESTLE CARRYING FRAME OF FLUME



DETAILS OF THE PRECAST SECTION LOCATED NEXT TO THE TOP OF THE TRESTLE

Dap along the top chord of section is not shown in this drawing

Originally, it was planned to grout only the angle braces running from bent to girder, but during construction it was found desirable to use grout between sections at various points, particularly in placing the cradles.

On the higher trestles, horizontal braces running the full length of the structure longitudinally were placed 8 ft. apart vertically. These braces consisted of 15-ft. beams spanning from bent to bent and resting upon the horizontal members of the sections. These were held in place by their own weight, any lateral thrust being taken by the shoulders provided on each beam end. Concrete abutments were provided where the ends of these longitudinal beams reached the ground line.

The trestles were designed by Thomas H. King, office engineer for the San Dieguito Mutual Water Co., and were erected under the direction of E. W. Case, chief engineer. Bent Brothers of Los Angeles were the contractors.

Correction

Through a typographical error, the letter L was omitted from the numerator of the expression for D in Equation (4), *Engineering News-Record* of May 8, 1919, p. 921, in the article "Computation of the Time Required to Fill a Graving Dock," by Eugene E Halmos. The expression should read $\frac{2lmL}{K\Sigma a\sqrt{2g}} = D$.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

New Edition of Structural Handbook

STRUCTURAL ENGINEERS' HANDBOOK: Data for the Design and Construction of Steel Bridges and Buildings—By Milo S. Ketchum, C. E., M. Am. Soc. C. E., Dean of the College of Engineering and Professor of Civil Engineering, University of Colorado; Consulting Engineer. Second Edition. New York: McGraw-Hill Book Co., Inc. Flexible Cover, 6 x 9 in.; pp. 896; illustrated. $5.

In the second edition of this widely used structural engineers' handbook, the first edition of which was reviewed in *Engineering Record* of Nov. 28, 1914, p. 598, and *Engineering News* of Mar. 18, 1915, p. 530, no attempt has been made by the author to carry out the complete and thorough revision which had been planned, chiefly owing to performance of war duties as the assistant director in charge of construction, United States Government Explosives Plant at Nitro, W. Va. Errors have been corrected and 16 pages added in Chapter I illustrating standard details for steel windows and doors, giving data on cement and gypsum tile roofs, and presenting methods and formulas for computing stresses in mill-building columns and in rigid frames.

Chapter III, treating of steel highway bridges, has been largely rewritten and enlarged by the addition of 16 pages of new matter. The added data include the bridge standards of the Wisconsin and Iowa highway commissions, results of various tests on floor-slabs, a complete discussion of the distribution of concentrated loads to stringers in bridge floors, a treatment of wearing surfaces, useful tables and diagrams to assist in the design of floors for various motor-truck concentrations, and reproductions of standard details of the later highway-bridge designs issued by various highway commissions.

In typography and general appearance the new edition is an improvement over the old.

Revision of "Irrigation Engineering"

REVIEWED BY F. H. NEWELL

Professor of Civil Engineering, University of Illinois, Urbana

IRRIGATION ENGINEERING—By Arthur Powell Davis, D.Sc., M. Am. Soc. C. E., Director and Chief Engineer U. S. Reclamation Service, Author of "Irrigation Works Constructed by the United States," etc.; and Herbert M. Wilson, C. E., M. Am. Soc. C. E.; Former Chief Engineer and Irrigation Engineer, U. S. Geological Survey; Author of "Topographic Surveying," etc. Seventh Edition, Revised and Enlarged. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 640; illustrated. $4.50.

New data and general conclusions based on recent practice are offered to students and to engineers engaged in irrigation investigation, construction and management, in the Davis or seventh edition of Wilson's "Irrigation." The original work, long regarded as the *vade mecum* on water control and its application to dry lands, revised from time to time by the original author, has been rearranged and brought up to date to such an extent as to justify considering this as practically a new book; the added facts and deductions are adequate to form in themselves a valuable treatise.

The older data, acquired by Mr. Wilson during his visits to India, Egypt and other irrigated lands, serve, while forming the essential background, to emphasize the rapid developments which have taken place on this continent in response to the demands imposed by American conditions, where, as pointed out, the high cost of labor as contrasted with that abroad requires entirely different methods of building and operation.

The more striking of the new facts, as might be supposed, are those which have come from the long experience of Mr. Davis who, as chief engineer of the United States Reclamation Service, has had intimate connection with a larger number and a greater variety of irrigation projects, under American conditions, than any other person. He has given especial consideration in his revision to the larger structural features, such as canal headgates, linings, spillways, drops, flumes and pipes—all well illustrated—and has also introduced a wealth of information on reservior construction, including the design and building of large dams.

Waterproofing Engineering

WATERPROOFING ENGINEERING: For Engineers, Architects, Builders, Roofers and Waterproofers—By Joseph Ross, B.S., C. E., Waterproofing Engineer. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 442. $5.

Waterproofing is too often considered one of the minor details of engineering, something which can be left for odd moments of design and which requires little thought or effort in construction. It happens, however, that when there is need at all for waterproofing there is very great need, and instances are far too common when repairs required by faulty waterproofing greatly exceed any preliminary expense which should have been put into original waterproofing design. For these special cases, then, a book on waterproofing engineering practice will be useful, although there must be much that is elementary in any exhaustive treatment of the subject. This would seem to be the main criticism of Mr. Ross' book. It treats fully the subject of waterproofing, but in an effort to make a complete exposition he has entered into so many of the elements of the subject as to make it somewhat difficult to follow the treatment throughout the whole volume. If the book is used purely for reference, picking out as required the details of construction which apply to any case in hand, it is valuable. Considering it as a students' manual or as a book to be read by the engineer, much will have to be passed over.

Rigid Concrete Frame Analysis

ANALYSIS AND TESTS OF RIGIDLY CONNECTED REINFORCED-CONCRETE FRAMES—By Mikishi Abe, Formerly Student in the Graduate School of the University of Illinois. Urbana, Ill.: Engineering Experiment Station. Paper; 6 x 9 in.; pp. 106; illustrated.

Reinforced-concrete frames are peculiarly adaptable to analysis as a rigid system. Such a method of analysis has been common in continental European practice for some years, and has had a fairly wide application in this country recently. The exact determination of the stresses and the consequent close designing make the method attractive, although its application has been

somewhat complicated. In this bulletin the author goes very thoroughly into the theory of design and checks this theory by a rather limited set of tests on large-size rigidly connected concrete frames. All concrete designers who are interested in the development of their art would do well to study this exposition of the tests.

Mathematics for Engineers

MATHEMATICS FOR ENGINEERS, PART I: Including Elementary and Higher Algebra, Mensuration and Graphs, and Plane Trigonometry—By W. N. Rose, B.Sc. Eng. (London), Lecturer in Engineering Mathematics at the University of London Goldsmiths' College. New York: E. P. Dutton & Co. Cloth; 6 x 9 in.; pp. 510; illustrated. $5.

This first volume of two planned as a systematic and complete treatment of the subject includes proof of rules, etc., with practical illustrations well chosen from engineering practice. Methods of calculation, algebraic processes, mensuration of simple areas and solids, including conic sections, graphs and charts, earthwork problems, slide rule and planimeter work, are all well handled. This is one of "The Directly-Useful Technical Series" (D. U. Series) of which Wilfrid J. Lineham is editor.

Relation of Land Slides and Glacial Deposits to Reservoir Sites

RELATION OF LANDSLIDES AND GLACIAL DEPOSITS TO RESERVOIR SITES IN THE SAN JUAN MOUNTAINS, COLORADO—By Wallace W. Atwood. Washington, D. C.: U. S. Geological Survey. Paper; 6 x 9 in.; pp. 38; illustrated.

Geology as an allied science has little interest to a number of engineers, but to those concerned with the construction of dams it is, perhaps, the principal minor study which they must pursue. The United States Geological Survey Bulletin noted here should be of great aid to all dam builders. While it describes the formations of a limited area of this country, it is an area which contains a great number of dams and one in which subsurface conditions have been particularly difficult. The analysis of the geological formation and the consequent infiltration of the water through strata beneath the dam has application to other locations.

Two New Books on Shipbuilding

THE ELEMENTS OF WOOD-SHIP CONSTRUCTION—By W. H. Curtis, Naval Architect and Marine Engineer. New York: McGraw-Hill Co., Inc. London: Hill Publishing Co., Ltd. Cloth; 6 x 9 in.; pp. 223; illustrated. $2.50.

THE SHIPBUILDING INDUSTRY—By Roy Willmarth Kelly, Director, Harvard Bureau of Vocational Guidance, Author of "Hiring the Worker," and Frederick J. Allen, Assistant Director, Harvard Bureau of Vocational Guidance, Author of "The Shoe Industry." With an Introduction by Charles M. Schwab. Boston and New York: Houghton Mifflin Co. Cloth; 6 x 9 in.; pp. 303; illustrated. $3.

Two new publications dealing with shipbuilding prove to be of radically different character. Curtis' "Elements of Wood-Ship Construction" is an excellent technical monograph, logically arranged, concise, clear and judiciously illustrated. On the other hand, the reader is entitled to a warning against "The Shipbuilding Industry," which is not a technical book at all, but may from its title be thought to be in part scientific or scholarly. It is a piece of "popular," or, more accurately, Sunday-magazine, writing, consisting of a confused mass of heterogeneous statements in which there is much gross misinformation. The reason for the preparation and publication of the book, say the authors, is that many more men must become shipyard artisans, and the book may "help them to decide for themselves whether or not they are qualified to undertake any of the work which it describes." That is, it is intended as a recruiting device, though it does not seem likely to show very high efficiency in this service.

Our critical shortage of shipworkers also led to the writing of Curtis' book, which is based on an instruction text prepared by the author for the Emergency Fleet Corporation. But in this instance a product of lasting value resulted. The steps in building a wooden ship are described sequentially, and the mechanical interrelation of the successive steps as well as the character of workmanship required are made apparent to the student in remarkably clear manner. Design, or the why of shaping the parts of a ship as the drawings show them, is not touched directly, but the reader can hardly fail to acquire much inferential knowledge concerning it. An unusual number of illustrations, which show excellent judgment on the author's part in deciding on scope, scale and detail of explanatory drawings, support the text.

Designing Concrete Mixtures

DESIGN OF CONCRETE MIXTURES—By Duff A. Abrams, Professor in Charge of Laboratory, Lewis Institute. Chicago, Ill.: The Institute. Paper; 6 x 9 in.; pp. 20; illustrated.

Extensive extracts from this bulletin were given in *Engineering News-Record* of Apr. 17, 1919, p. 758, but every concrete engineer, or contractor working in concrete, should get a copy of the full report, for study. Professor Abrams has been conducting a monumental series of tests on the properties of concrete, and has announced some very definite views, backed up with laboratory facts. Some of these views are going to be subjected to searching inquiry in the next few months, and the controversies which will arise will undoubtedly be among the most alive of any that have stirred the concrete industry. It behooves every one interested to be well informed, therefore, on the basic tests reported here.

Packing Engineering Material for Export

An instruction book for packing engineering material for exportation to foreign countries has been issued by the Engineer Corps, U. S. A. This book should be interesting to all those who have problems in packing similar material for export. Seven subjects are treated in the book. The first four are from standard specifications of the War Department and are as follows: Crating, boxing, wire-bound boxes, and baling. Two subjects are taken from the specifications of the General Engineering Depot. The first one discusses "The Problem," the second, "Packing Specifications." The last division covers "Marking of Packages." The book is 5 x 7¾ inches in size, contains 63 pages, and is illustrated.

Helping Disabled Soldiers to a Vocation

Among the "Opportunity Monographs" in the Rehabilitation Series designed to aid disabled soldiers, sailors and marines in choosing a vocation are No. 6, "Safety and Fire-Protection Engineering"; No. 9, "Oxy-acetylene Welding," and No. 13, "Concrete Construction and Cement Manufacture: Engineer or Architect, Inspector, Contractor, Superintendent, Foreman, Machine Operators, Modelers, Pattern Makers." (Federal Board for Vocational Education, Washington, D. C.)

Book List for Disabled Soldiers

As one of the many aids toward putting disabled soldiers in the way of earning their living to the best advantage of themselves and of the country, the American Library Association, through its library war service, which has its headquarters in the Library of Congress, Washington, D. C., has issued a "Reconstruction Hospital List; Books on Subjects Taught in Reconstruction Hospitals." No less than 150 subjects are covered, ranging alphabetically from advertising and agricultural engineering to wiring and wood finishing. Other subjects that may be mentioned are chemistry, farm machinery, forestry, irrigation farming, landscape gardening, railroad engineering, sanitation, and steam engineering. Various occupations are also included, as well as a wide range of science, art and literature.

Dining Rooms for Industrial Plants

More and more industrial plants are building dining rooms of one sort or another for the accommodation of their workers. Very little literature on the subject is available for those engineers who are called upon to lay out such accommodations. Therefore, a recent pamphlet issued by the William Disston Co., of Tacony, Penn., describing the new cafeteria which has been built at its manufacturing plant outside of Philadelphia, should be valuable. This plant was designed under the direction of A. S. Blum, chief engineer of the company, and the pamphlet, which can be obtained from the Disston company, was prepared by Mr. Blum.

PUBLICATIONS RECEIVED

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be obtained without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or, in case of books or papers privately printed, then to the author or other persons indicated.]

AMERICAN CONCRETE PIPE ASSOCIATION CONVENTION: Official Proceedings, Feb. 14-15, 1919. Chicago, Ill.: The Association. Paper; 6 x 9 in.; pp. 93; illustrated.

CALIFORNIA, STATE ENGINEERING DEPARTMENT, Sixth Biennial Report, Dec. 1, 1916 to Nov. 20, 1918. Sacramento, Calif.: California State Printing Office. Paper; 6 x 9 in.; pp. 93; illustrated.
Reports on various phases of the California water problem—irrigation development, water conservation, flood control and land reclamation, river navigation and the mining débris problem; San Francisco's harbor-front improvements; snow studies.

CHICAGO BOARD OF LOCAL IMPROVEMENTS: Quadrennial Report to the Mayor and City Council, for 1915-18. Chicago, Ill.: The Board. Paper; 6 x 9 in.; pp. 100; illustrated.
Outlines the history of this board from its inception in 1897, and reviews the work of its paving, sewer, civil and other divisions. The board has charge of the initiation and execution of public improvements paid for in whole or in part by special assessments. Certain acts of the board are subject to approval by the City Council and others by the courts.

COMMUNITY LEADERSHIP: The New Profession—By Lucius E. Wilson, Vice-President of the American City Bureau. New York: The Bureau. Cloth; 5 x 7 in.; pp. 137. $1.50.

EXPERTS IN CITY GOVERNMENT—By Edward A. Fitzpatrick, Ph.D., Director, Society for the Promotion of Training for Public Service: Editor, "The Public Servant." National Municipal League Series. New York and London: D. Appleton & Co. Cloth; 5 x 8 in.; pp. 363; illustrated. $2.25.

FLORIDA STATE ROAD DEPARTMENT: Second Biennial Report, Oct. 1, 1916, to Sept. 30, 1918. Tallahassee, Fla. The Department. Paper; 6 x 9 in.; pp. 47; illustrated.

THE GOVERNMENT OF THE UNITED STATES, NATIONAL, STATE AND LOCAL—By William Bennett Munro, Ph.D., LL.B., Professor of Municipal Government in Harvard University. New York: The Macmillan Co. Cloth; 6 x 9 in.; pp. 648. $2.75.

HOW AMERICAN MANUFACTURERS VIEW EMPLOYMENT RELATIONS—By Stephen C. Mason, President of the National Association of Manufacturers. New York City: The Association, 30 Church St. Paper; 6 x 9 in.; pp. 11.

HOW FRANCE IS GOVERNED—By Raymond Poincaré of the French Academy and President of the Republic; Translated by Bernard Miall. New York: Robert M. McBride & Co. Cloth; 5 x 8 in.; pp. 336. $2.

INDUSTRIAL GOODWILL—By John R. Commons, University of Wisconsin. New York: McGraw-Hill Book Co., Inc. London: Hill Publishing Co., Ltd. Cloth; 6 x 9 in.; pp. 213. $2.

INFLUENCE OF THE GREAT WAR UPON SHIPPING—By J. Russell Smith, Professor of Geography and Industry, University of Pennsylvania; Carnegie Endowment for International Peace: Preliminary Economic Studies of the War, Edited by David Kinley, Professor of Political Economy, University of Illinois; Member of Committee of Research of the Endowment. Washington, D. C.: Carnegie Endowment for International Peace. Paper; 7 x 10 in.; pp. 357.

LABOR TURNOVER, LOYALTY AND OUTPUT: A Consideration of the Trend of the Times as Shown by the Results of War Activities in the Machine Shops and Elsewhere—By Fred H. Colvin, Associate Editor *American Machinist*; M. Am. Soc. M. E., and Franklin Institute. New York: McGraw-Hill Book Co., Inc. Cloth; 5 x 8 in.; pp. 152; illustrated. $1.50.

MAINE STATE HIGHWAY COMMISSION: Fifth Annual Report, Jan. to Dec., 1917. Augusta, Me. The Commission. Paper; 6 x 9 in.; pp. 61.

MANUAL OF GURLEY HYDRAULIC ENGINEERING INSTRUMENTS. Troy, N. Y.: W. & L. E. Gurley. Cloth; 6 x 9 in.; pp. 139; illustrated. 50c.
Although primarily a trade catalog, this volume has a broader scope. Besides describing the current meters and water-stage recorders made by the publishers, the book contains a considerable amount of general information on hydraulic measurements, including some tables.

NEW YORK STATE COMMISSIONER OF HIGHWAYS: Report Transmitted to the Legislature Feb. 15, 1918. Albany, N. Y.: The Commissioner. Cloth; 6 x 9 in.; pp. 592.

OFFICE ADMINISTRATION—By J. William Schultze, B.C.S., C.P.A., with William Demuth & Co.; Formerly Controller, Robert H. Ingersoll & Bros., Etc.; Author of "The American Office," "Production Records," Etc. New York: McGraw-Hill Book Co., Inc. London: Hill Publishing Co., Ltd. Cloth; 6 x 9 in.; pp. 295; illustrated. $3.
A book written to meet the requirements of the business executive and business student by discussion of the principles and methods which underlie efficient and economical office management, including office layout.

OREGON STATE ENGINEER, SEVENTH BIENNIAL REPORT TO THE GOVERNOR: For the Period Beginning Dec. 1, 1916, ending Nov. 30, 1918—By Percy A. Cupper, State Engineer. Salem, Ore.: The Author. Paper; 6 x 9 in.; pp. 30; illustrated.

PHYSICAL PROPERTIES OF DENSE CONCRETE AS DETERMINED BY THE RELATIVE QUANTITY OF CEMENT—By F. E. Giesecke and S. P. Finch. Bureau of Economic Geology and Technology, J. A. Udden, Director Division of Engineering, F. E. Giesecke, Head of the Division. University of Texas Bulletin. Austin, Texas: The University. Paper; 6 x 9 in.; pp. 85; illustrated.

THE REDEMPTION OF THE DISABLED: A Study of Programs of Rehabilitation for the Disabled of War and of Industry—By Garrard Harris, Research Division, Federal Board for Vocational Education; With an Introductory Chapter by Frank Billings, Colonel, Medical Corps, U. S. A.; and a Foreword by Charles A. Prosser, Director of the Federal Board for Vocational Education. New York and London: D. Appleton & Co. Cloth; 5 x 8 in.; pp. 318; illustrated. $2.

REST PERIODS FOR INDUSTRIAL WORKERS: Research Report No. 13, January, 1919. Boston, Mass.: National Industrial Conference Board. Paper; 6 x 9 in.; pp. 55.

SAND AND GRAVEL IN 1917—By R. W. Stone. Washington, D. C.: U. S. Geological Survey. Paper; 6 x 9 in.; pp. 15.

STANDARD SPECIFICATIONS FOR WROUGHT-IRON PLATES: Spanish Text as Adopted by the American Society for Testing Materials. Washington, D. C.: Bureau of Foreign and Domestic Commerce. Paper; 6 x 9 in.; pp. 13. 5c. from Superintendent of Documents.

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WASHINGTON STATE WATER CODE AND ITS ADMINISTRATION—By Marvin Chase, State Hydraulic Engineer. Olympia, Wash.: The Author. Paper; 6 x 9 in.; pp. 53; illustrated.

WHY OUR SHIPS WILL NOW STAY ON THE OCEAN—By Edward N. Hurley, Chairman, U. S. Shipping Board, Philadelphia, Penn.: U. S. Shiping Board, Emergency Fleet Corporation. Paper; 6 x 9 in.; pp. 14.

SOCIETY SERVICE

A Section Dealing with the Results of Teamwork by Technical Men

Questionnaire by Oregon Society

The following questionnaire is being sent to members of the Oregon Society of Engineers, in order to draw out their opinions and develop suggestions:

1. Are you satisfied to have the Oregon Society continue in its past course?
2. What do you consider the proper activities to make the society a vital moving force among engineers?
3. Do you favor the society looking more actively to the business interests of engineers?
4. Shall we establish an effective employment department?
5. Do you favor the establishment of a scale of minimum salaries and fees?
6. Do you favor taking an active and aggressive part in legislation affecting engineers?
7. Do you favor affiliation in any way with existing trade unions?
8. Are you familiar with the aims of the American Association of Engineers?
9. Do you favor affiliation with the American Association?
10. Do you favor coöperation with local chapters of the national societies and other local engineering bodies?
11. What form of such local coöperation do you suggest?
12. Shall we establish a downtown office headquarters?
13. Shall we acquire clubroom facilities?
14. Would you advocate the increase of our present annual dues if clubroom and library facilities were provided?
15. Would you support a luncheon conducted in connection with clubrooms?
16. Would you support weekly or biweekly engineers' luncheons such as we have had in the past?
17. Do you favor increased attention by the society to social activities among engineers?
18. Would you attend an engineers' dance?
19. Make us a helpful suggestion. Answer in as much detail as you like. Paper is cheap and ideas are wanted.
20. What can the society do to better serve out-of-town members?

Engineers' Club Plans Larger Activities

The Engineers' Club of the Youngstown district, Youngstown, Ohio, is making a drive for greatly increased membership. At its April meeting, with an attendance of 347, it was announced that 625 applications had been received. The club covers the territory within a radius of 25 miles, including several other cities, and it is estimated that there are 1500 men eligible for membership. It is planned to have the club active in coöperation with civic bodies and such commercial organizations as boards of trade and chambers of commerce in regard to problems of an engineering character. The membership is of five classes, admitting those in all branches of engineering, architecture, chemistry and applied science, and also those interested in the advancement of engineering. It has been voted to lease a floor of the Park Theater Bldg. for headquarters. The president is F. W. Funk; the vice-president is W. H. Ramage, and the secretary is E. R. Rose, Republic Iron & Steel Co., Youngstown, Ohio.

Publicity by Engineering Societies Promises Good Results

Passage of the Iowa engineers' registration law was helped materially by the hard work of the Iowa Engineering Society and of engineers who took time for nearly a month to make members of the legislature realize the public benefit of the measure. It is considered evident that engineers can exert considerable influence in public affairs if their efforts are properly coördinated, and that state engineering societies may be powerful agencies in securing proper appreciation of the engineering profession by the public. Educational publicity work of this kind will do much to make clear to the legislator and the average citizen the scope and importance of the engineer's work.

Societies Submit Names for Board of Engineer Examiners

At a dinner to representatives of various technical societies given by Calvin W. Rice, secretary of the American Society of Mechanical Engineers, at the University Club, Denver, Colo., the license law recently passed in Colorado was discussed, and the question of the appointment of members for the board of engineer examiners was raised. It was resolved that each society represented at the dinner should choose three of its members for candidates, and that these names should be submitted to the Governor.

As a result the following list of names has been forwarded to the Governor: For the Colorado Association of Members of the American Society of Civil Engineers, Prof. Milo S. Ketchum, C. W. Comstock, and J. C. Ulrich; for the American Institute of Mining and Metallurgical Engineers, Richard A. Parker, R. J. Grant and John T. Milliken; for the American Institute of Electrical Engineers, Prof. H. S. Evans, Franklin D. Wood and C. W. Comstock; for the American Society of Mechanical Engineers, J. B. McKennan, W. J. Reilly and Prof. J. A. Hunter; for the Colorado Scientific Society, D. W. Brunton, George O. Argall and H. S. Sands; for the Teknik Club, M. S. MacCarthy and L. L. Davis; for the Colorado Society of Engineers, R. M. Hosea, F. W. Whiteside and V. A. Kauffman.

Sanitary Engineers Condemn Shallow Wells

At a recent meeting of the Indiana Sanitary and Water-Supply Association shallow wells and privy vaults were condemned by resolution, as were dual water-supplies (one of which may be contaminated) and physical connections to industrial-plant supplies. Of the 500,000 wells in the state more than 2% have been tested in the past 12 years and 61% of these found to be bad. The privy vault and the back-yard well are both of vital concern to the sanitary engineers in Indiana, for water is easy to obtain and equally easy to contaminate.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Draftsman's and Shoemaker's Salaries

Sir—With reference to the letter from C. H. McGarry, in your issue of Apr. 24, 1919, p. 835, quoting from the April bulletin of the Civil Service Commission of Ohio announcing the examinations for positions of architectural draftsman and of shoemaker, I wish to make the following statement:

In so far as Mr. McGarry's letter might be interpreted by some readers as being a criticism of the Ohio Civil Service Commission, a brief description of the method in which the salaries for the positions in question are fixed is pertinent. The state department (in this case the Ohio Board of Administration) submits its request for salaries of its employees to the Budget Commissioner, who passes upon the request and forwards it, with his recommendations, to the Governor. The Governor transmits his recommendations, based upon the reports of the Budget Commissioner, to the legislature. The legislature, after making any changes it may deem advisable, makes a direct appropriation for salaries. The Civil Service Commission is not consulted in regard to the salaries, but is required to fix the grades and qualifications for the positions.

A careful consideration of the salaries paid, in connection with the nature of the two positions in question, would disclose the following points: The entrance salary of the architectural draftsman is $1500 per annum with no maximum limit designated. That of the shoemaker is $1200 with maximum limit of $1400 per annum.

The position of architectural draftsman affords excellent experience, which can be used by the incumbent as a means for future advancement. The position of shoemaker is "Grade 1" in the skilled labor service, and is practically without further possibilities to the shoemaker incumbent.

In connection with tnese examinations, it might be interesting to know that there were five applicants for architectural draftsman, and one applicant for shoemaker. G. F. SCHLESINGER.

Assistant Chief Examiner, The State Civil Service Commission of Ohio.
Columbus, Ohio.

Interpretation of Overhaul Specification

Sir—A letter from R. G. Williams in *Engineering News-Record* of Apr. 24, 1919, p. 835, asks for interpretations of a certain specification for overhaul.

This specification states that "payment for overhaul . . . . shall be the product of . . . . . tons of material . . . . . by its distance in miles (and fractions thereof) less one mile, of its *center of mass* from the points of locations. . . . (The italics are mine.)

Thus, in the first overhaul mile, i.e., the space covered between, say, mile post 1 and mile post 2 from the pit: If there be 100 tons of material, assumed to be uniformly distributed, the location of its center of mass will be at mile post 1½, and the overhaul paid should be 100 tons multiplied by ½ mile or 50 ton-miles, which, at 25c., unit price, amounts to $12.50, as claimed by the engineer. F. T. HOWES,

Resident Engineer, Northern Pacific Railroad.
Emigrant, Mont.

Sir—In your issue of Apr. 24, 1919, p. 835, R. G. Williams asks what is the correct interpretation of an overhaul specification.

In analyzing the specification I believe the following points should be taken into consideration:

1. The first sentence plainly says that the free haul shall be one mile from the pit or loading point. There is no uncertainty in this statement.

2. The second sentence says that for each mile or fraction thereof in excess of the one-mile free haul the contractor shall be paid for overhaul at the rate bid per ton-mile, which is 25c. This clearly means that the contractor shall receive 25c. per ton-mile for every ton of material hauled beyond the first mile, whether the material is hauled one foot past the first mile post or whether the material is hauled to any other point within the one- to two-mile zone.

3. The third sentence says that payment for overhaul shall be the product of the tons of material hauled times its distance in miles and fractions thereof less one mile, of its center of mass from the points of locations. The grammatical construction of this sentence is faulty and admits of two interpretations. The first part of the sentence which says payment of overhaul shall be "the product of tons of material hauled times its distance in miles and fractions thereof less one mile" is clear and must be construed as outlined in paragraph 2 above. The second part of the sentence goes on to say "of its center of mass from the points of location," and indicates that the engineer probably had some idea of paying for an average haul. However, he does not say so in good English.

The contractor in this case should have asked the engineer for his interpretation of this sentence before submitting his bid. This evidently was not done. On the other hand, the engineer has failed to write a clear specification.

A reasonable interpretation of the specification would be for the engineer to pay the contractor on the same basis, using the ton-mile unit of 25c., as other contractors are being paid on similar work in that state or that section of the state. NEWMAN B. GREGORY.

Walnut Ridge, Ark. General Contractor.

Joints in Concrete-Road Work

Sir—The lively interest in and discussion on transverse expansion joints in the construction of concrete highways will lead to a logical and proper solution. There is a significant tendency to abandon all joints, and, in some localities and under certain conditions this seems to be a sane departure from the theoretical idea of their importance. However, it will be best to act with caution, owing to the fact that concrete laid at or near freezing temperatures will, under summer heat, show expansion and may buckle or crush. Again, there is danger of expansion from moisture during rainy seasons, especially if the coarse aggregate used is absorbent or if the binder of cement and sand is not rich and dense enough to avoid penetration of moisture.

The blind joint is, in my judgment, the best type. This style of joint is most easily produced by placing a 4-in. weatherboarding, thin edge up, across between the forms and resting it on the subgrade. This will cut the slab from the bottom to about the center for standard work. As the work shrinks in curing, the cleavage will be over this board. The future behavior of the work will determine whether any treatment of the crack is advisable. We place this joint at the end of each day's work, or about every 400 feet.

If bituminous expansion strips are used for joints, the maximum thickness should not exceed ½ in., and my present judgment and experience tend to condemn them entirely. They do not properly support and protect the edges of the concrete. In all cases where joints are inserted, either blind wood or bituminous, they ought not to cross the slab at right angles, but should cross as the segment of a circle.

This "rainbow" type is easily produced by using a strip of joint material of such length as will, when sprung into place between the forms, give the desired radius or curve. If the roadway be 18 ft. wide and we use a strip of joint material 18 ft. 4 in. in length, we shall produce a bow of 18 in. at the center of the roadway.

In case the specifications are old and the engineer in charge is ultra-conservative, thus forcing the elastic joint on the contractor and into the work, it is best to use a light metal templet not over $\frac{3}{16}$ in. thick sprung into position for placing the joint material. The strips of material may then be placed against the outer or convex surface of the templet and be held in place by driving light, wooden stakes into the subgrade, so as to hold the strips against the metal. Lifting out the templet is made easy by drilling two small holes near the top, say 4 in. from each end, and using small lifting hooks. In case wooden strips are used as mentioned above and left in, there is a total elimination of all labor after placing.

The "rainbow" type has many features of preference and should supersede the straight line in future work, whenever it is required to place joints of any description. Its appearance is more pleasing to the eye, and the wheel contact with the joint is better for both the driver and the vehicle. As in crossing car tracks at variance from a right angle, the thrust is only on one wheel at a time, as one passes over before the other reaches the curved line. The chug of both wheels at once gradually ravels the road at the crossing of the joint, and this is minimized by crossing the "rainbow" instead of a straight line. C. O. FRYE.

Tulsa, Okla.

Concrete Road with Bituminous Carpet Wrongly Classified

Sir—In the Apr. 3 issue of *Engineering News-Record*, p. 670, data were given on the cost of maintenance of different types of highways in the City of Philadelphia. In this table 1:3:6 concrete was listed under "foundation" when placed under vitrified brick and Bicomac. When thin bituminous carpet was placed on the concrete base, the concrete was listed under "type of surfacing."

A 1:3:6 mix of concrete is not the proper mixture for concrete surface. Under modern specifications the weakest mix being used for concrete surfacing is 1:2:4. In the majority of cases the mixture is even stronger.

Where concrete base was placed with bituminous carpet, the concrete should have been carried under "type of foundation," as in the case of brick, and the surfacing should have been noted as "bituminous carpet."

I am calling this to your attention in the hope that you may correct in the minds of the readers of *Engineering News-Record* any wrong impression that they may have obtained in regard to the cost of maintenance on concrete highways. The average cost of maintenance on a properly constructed concrete highway is as low as on any other type of pavement, and the cost of maintaining a large mileage for this class of pavement surface for several years shows that it does not average over 1c. per square yard per year. A 1:3:6 foundation with a bituminous carpet coat is not a concrete surface, and should not be classed as such. B. H. WAIT,

District Engineer, Portland Cement Association.

New York City.

Union of British Women Engineers

Sir—In regard to the item on this subject in *Engineering News-Record* of May 1, 1919, p. 863, it might have been well to point out that in England the term "engineer" is used as synonymous with our term "machinist," and that the Amalgamated Society of Engineers is a machinists' labor organization. However, it appears that the women also want to become members of technical societies, but it is not clear that membership in a trade union will help them in this respect.

Chicago. ENGINEER.

Control of Fires in Cinder Fills

Sir—For those who are experiencing difficulty in the control of fires in cinder fills, as described in your issue of Apr. 10, 1919, p. 711, the method which has been used with success at the Rensselaer Polytechnic Institute may be of some interest and help.

For a number of years the cinders have been dumped into a natural ravine close to the boiler house, and the fill probably reaches a depth at present of about thirty feet.

Considerable difficulty had been experienced from time to time with fires. Attempts were made to quench these by applying a large volume of water from a hose, but the attempts met with indifferent success. On one of these occasions there was danger that the fire might spread to soft coal stored near by, and the necessity for some more certain means of fighting it led to the adoption of the following plan:

A gridiron was constructed of several ¾-in. pipes, with tees spaced about 8 ft. apart. Into these tees were screwed other pipes about 6 ft. high, and upon the top end of each of these was screwed an automatic sprinkler head from which the disc had been removed. The whole arrangement was placed on top of the cinder fill over the place where the fire seemed to be, and connected by a rubber hose to the water supply. The water thus applied was distributed uniformly over the location of the fire and was very effective in its action. Usually not more than four sprinkler heads were required to quench the fire completely in a few days' time.

LE ROY W. CLARK,

Assistant Professor of Mechanics, Rensselaer Polytechnic Institute.

Troy, N. Y.

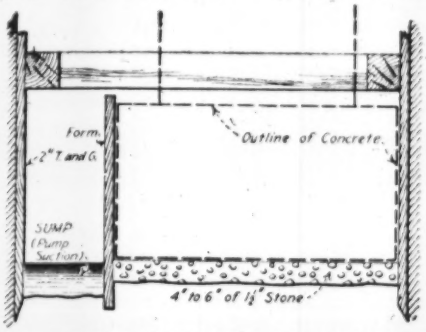
HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Sump and Drain Keep Footing Pit Dry

By A. P. ROSCOE
Ozone Park, N. Y.

USING the arrangement depicted by the accompanying drawing, concrete was placed without trouble from water in constructing elevated-railway column footings in New York City. The pits varied from



SUMP KEEPS FOUNDATION PITS DRY FOR CONCRETING

7 x 7 x 10 ft. to 9½ x 9½ x 12 ft., and ground-water level ranged from 2 ft. to 9 ft. above the pit bottoms. Tongue-and-groove sheeting was driven by hand and by steam hammer, and the water was kept down by steam pumps and gasoline-driven diaphragm pumps. As the drawing indicates, the sheeting was driven to the neat lines of the concrete on three sides, but on the fourth side it was driven 2 ft. outside the neat line. This gave a 2-ft. space for a sump which was excavated 6 in. deeper than the pit itself. A side form for the footing on the sump side was then set up, and the pit bottom was covered with 4 in. to 6 in. of 1½-in. broken stone. Water seeping into the pit drained through the broken stone into the sump and left practically dry the bottom on which the footing concrete was deposited. An open-joint tile drain embedded in the stone was laid across the pit bottom to the sump in the first few pits, but was afterward omitted as unnecessary.

Simple Device Decreases Loading Costs

By MAX MILLER
Engineer, M. Shapiro & Son, New York City

AN INEXPENSIVE device successfully used on concrete work resulted in a saving of a considerable percentage of loading and carting costs. As indicated by the illustration, it consists of a simple box made of old lumber and measuring about 5 x 7 ft. in plan by 1 ft. 6 in. deep. It holds about 2 cu. yd. of material and loads a motor truck by one operation in a few minutes. The box is arranged to rest on the side of the open railroad car in which the material is received, is slightly overbalanced outward, and is dumped by the release of a rope at the end of a lever at its back, which is fastened to the opposite side of the car.

On the job where this was used it took as long to fill the truck by the ordinary hand shoveling as was required for the truck to make a complete round trip. The device, therefore, practically doubled the number of trips per day for each truck. Furthermore, the loading laborers were continually busy filling the box and did not lose time waiting for the truck to come alongside of the car.

BOX ON SIDE OF RAILROAD CAR DUMPED BY RELEASE OF LEVER

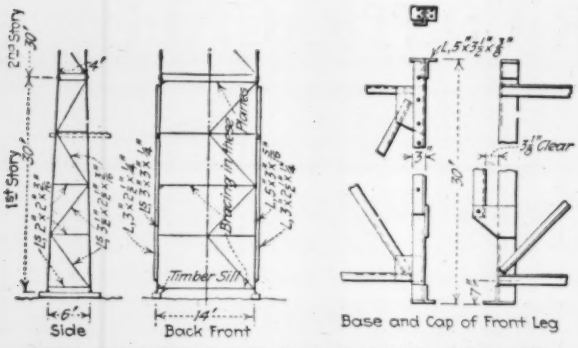
The device was used by M. Shapiro & Son, for whom the writer is engineer in charge of construction on the masonry, foundations and concrete work for the new Strand Theatre at Far Rockaway, N. Y.

Steel Scaffold Towers Reduce Handling at Fore River Shipyard

A DISTINCT simplification in ship-erection scaffolding is found at the Fore River shipyard of the Bethlehem Shipbuilding Corporation, Ltd., at Quincy, Mass. The supports are steel towers 6 x 14 ft. at the base, built in heights of 30 ft. and so detailed that a second story can be set on top of the first without trouble, and attached by a few bolts to keep it from shifting. Placing ledger planks to support the scaffold runways involves no more trouble than with wooden scaffolding. As shown in the detail sketches, an angle is attached to each of the tower leg angles by outstanding gusset plates in

Other Articles in This Issue of Interest to Contractors:

Concrete-Highway Construction Standards Raised — Page 955
Improving Concrete by Rodding — Page 957
Frozen Concrete Thawed by Putting Warm Concrete on Surface — Page 964
Demobilizing Equipment of Spruce Production Division — Page 967
Construction Firm Finds Personnel Work Profitable (Editorial Interview) — Page 970
Interpretation of Overhaul Specification (Letter) — Page 983



STEEL SCAFFOLD UNITS AT FORE RIVER SHIPYARD

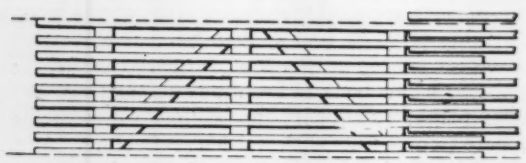
such position as to leave a clear space 3 in. wide between the two angles. The ledger boards are passed through this space, and are held by steel pins passed through holes in the two angles above and below the board.

Timber sills are attached to the foot of the tower, and thus the tower becomes a self-contained unit, which the shipbuilding cranes can easily pick up and place anywhere along the ship. As soon as it is set on the ground it is stable without bracing, and the ledgers and runways can be put in position. Because of the absence of timber bracing, the working space around the bottom of the ship is much clearer of obstructions than with the ordinary scaffolding made of independent bents.

The idea of self-contained scaffold units is credited to S. W. Wakeman, former general manager of the yard and now general manager of the eastern district of the Bethlehem Shipbuilding Corporation, Ltd., which embraces a number of yards and manufacturing plants. The towers were built by the New England Structural Co., of Everett, Mass. They have been in service about two years, and in that period little expense for repairs has been incurred. Compared with timber scaffolding they are regarded as virtually free from deterioration.

Timber Grid Floor Forms With Sheet Iron Covering

FLOOR-FORMS consisting of wood grids over which sheet iron was tacked were an important factor in the unusually rapid concreting operations in constructing the Boston Army supply base described in *Engineering News-Record* of Sept. 19, 1918, p. 522. The grids, as shown by the sketch, consist of 2 x 3-in. sticks set parallel on edge 3 in. apart and cleated together to form mats 3½ x 12 ft. in size. As shown, the ends of abutting mats can be telescoped to provide longitudinal adjustment. A succession of these mats was laid over the floor area, being supported on 4 x 6-in. stringers spaced 5 ft. apart and carried on 3 x 4-in. posts set about 5 ft. apart. Over the tops of the mats thus assembled was tacked No. 22-gage sheet iron which could be lapped in any direction to cover a given space without cutting. The grids, when sturdily built, could be used at least 10 times, and the sheet metal, which was rolled after each usage, was good for re-use from 12 to 15 times. Maj. Charles R. Gow was constructing quartermaster and the W. F. Kearns Co., Boston, Mass., was the general contractor for the base.



GRID AND SHEET-IRON COVERING CAPABLE OF REPEATED RE-USE

Check Bidding Prices Against List of Possible Cost Items

THERE are so many items of cost in road construction that memory alone is a feeble guarantee that all have been included when the contractor submits his sealed bids. To prevent errors or omission the Prendergast-Clark Construction Co., of St. Louis, Mo., general contractors, with extensive experience in road building has compiled a list of items to be considered in estimating the cost of 1 sq.yd. of pavement on concrete highway, as follows: (1) Surety bond; (2) liability insurance; (3) installing railway sidings; (4) freight on equipment; (5) equipment; (6) installing equipment, building bins and cement shed; (7) laying and taking up track (industrial-railway outfit); (8) cement, sand, gravel or stone on railway siding; (9) unloading cement, sand, gravel or stone; (10) hauling cement, sand, gravel or stone to roadway; (11) pumping water; (12) operating mixer; (13) charging mixer; (14) spreading concrete; (15) finishing concrete; (16) sprinkling concrete; (17) canvas covering for concrete and cement; (18) earth covering for concrete; (19) form setting for concrete; (20) subgrade for concrete; (21) rolling subgrade; (22) bundling cement sacks and return freight to mill; (23) lost and damaged sacks; (24) oil, gasoline and coal; (25) interest; (26) depreciation, and (27) overhead. In appraising these items, careful scrutiny of the specifications is made vital by the changes in requirements which are constantly being introduced. The requirements for dry concrete, for example, introduce tamping and tamping machines which must be appraised under items 5 and 14. Many other of the items can be subitemized to advantage, but the list furnishes a fairly complete skeleton on which to build up a schedule of costs that will be reasonably complete. No schedule to be devised will obviate the necessity of a final allowance for contingencies.

C. S. H.

Tractor Operators Trained for Road Work

In view of the probable shortage of tractor operators to handle the machines which will be required on the extensive road work planned in Nebraska for this year, Prof. L. W. Chase, head of the agricultural engineering department of the University of Nebraska, organized a special short course in tractor instruction, similar to the course for tractor operators on agricultural work. The time was short, but posters were hurriedly prepared and distributed Apr. 3 announcing that this special course would begin Apr. 14. The newspapers also gave publicity to the new course. Instead of 15 to 25 attendants as expected, there were over 80, so that three sections were necessary, and for five days the lecture periods had to be doubled. The course consisted of two lectures and six hours' laboratory work each day for 20 days. The innovation was suggested by George E. Johnson, state engineer.

NEWS OF THE WEEK

New York, May 15, 1919

Price Stabilization Board Resigns

Following the failure of the Railroad Administration, the steel producers and the Industrial Board of the Department of Commerce to agree on steel prices, the members of the latter board May 8 presented their resignations to Secretary Redfield, who accepted them. This marks the end of the attempt to stabilize prices on the part of a Government bureau by announcement of a fair price.

New Record of Ship Production

April figures for shipbuilding in the United States establish a new high mark for deliveries of completed ships: Ninety-three vessels, of 320,280 gross tons, which is 57,000 tons higher than the previous record figure, made in October, 1918. With this month's report the Shipping Board has abandoned the use of dead-weight carrying capacity tonnage, and has gone over to gross tonnage.

Rapid-Transit Construction Under a Single Commissioner

Direction of subway and elevated-railway building in New York City will hereafter be in the hands of a single commissioner, under a law signed by Governor Smith of New York State during the past week. This law completes the replacement of the five-member Public Service Commission for the First District (New York City) by two independent commissioners, one in charge of utility regulation and the other in charge of rapid-transit construction. As noted in these columns last week, Lewis Nixon, who was appointed regulative public service commissioner, is administering the duties of both offices pending the appointment of a construction commissioner.

Government Scientists Organize Union at Washington

Scientific and technical employees of the Government, at a meeting held in Washington, May 10, organized a union which is to become a branch of the present Federal Employees' Union. There was a long discussion on the formation of an independent organization, which would in no way be connected with the present union of Federal employees, but this was decided against, by a vote of 185 to 132.

Dr. Edward B. Rosa, chief physicist of the Bureau of Standards, said that the work of the joint Congressional reclassification commission had brought to the forefront the question of an organization of scientific and technical workers more acutely than ever before. He also spoke in opposition to the plan for an independent organization, declaring that it would be practically without influence, but that in a union allied with other Federal employees the scientific and technical employees would be heard and recognized, and the desired results would follow.

P. G. Agnew, secretary of the new organization, pointed out accomplishments of the Federal Employees' Union, accrediting it with increasing the wages of Government employees and securing the appointment of the reclassification commission.

Employment Bureaus

Engineering Societies' Employment Bureau, 29 W. 39th St., New York City.

American Association of Engineers, 29 S. La Salle St., Chicago. Service to members only, but Army or Navy Engineers in uniform who are eligible to certified membership may join without payment of entrance fees or dues while in uniform and for six months after discharge.

Engineers' Service Bureau, 57 Post St., San Francisco. Only applications by mail or wire will be considered.

Professional and Special Section, United States Employment Service, 469 Fifth Ave., New York City.

Reëmployment Committee of New York City for Soldiers, Sailors and Marines, 233 Broadway, New York City.

Building War Department Concrete Steamers

Concrete river steamers for the use of the Army are to be built by the Newport Shipbuilding Corporation, Ltd., at its yard at Newbern, N. C. These ships, which were noted in *Engineering News-Record* of Jan 2, 1919, p. 65, are 130 ft. long and will be used as short-trip transports. Nine of them are contracted for.

More Harbor Bonds for Portland, Oregon

On June 3 the voters of Portland, Ore., will be asked to approve an additional bond issue of $1,000,000 to take care of any emergencies in the current improvement of the harbor and municipal port works. No definite use is indicated for the additional funds, but the port commission asks for the money to provide for contingencies.

Minnesota Drainage Control Reorganized by New Law

Complete reorganization of the state administration of land drainage in Minnesota is provided by a bill which has just become law through Governor Burnquist's approval. The original house bill was amended in the senate to provide an engineer commissioner, and in this form was passed and approved. The State Drainage Commission existing hitherto consisted of the Governor, the state auditor, and the secretary of state. The new law creates a Department of Drainage and Waters, to be headed by a commissioner ($4000 per year) appointed by the Governor for a term of four years. He is assisted by a deputy commissioner ($3000). The commissioner must be a practical drainage and hydraulic engineer.

In addition to the duties assigned to the old commission, the new department receives power to investigate the topographical features of the watersheds of the state; to ascertain the work necessary for securing proper drainage outlet for the lands in each basin and for preventing and controlling floods; to measure stream discharge; to determine drainage run-off coefficients; to establish rules and regulations governing the work of drainage engineers; to survey and establish the boundary lines of drainage basins or of organized drainage and conservancy districts; and to keep a record of all drainage improvements.

An important auxiliary feature of the law is a new schedule of maximum allowable compensation to be paid to engineers engaged in public drainage proceedings. The principal increases are: Engineers, from $10 to $12.50 per day; rodmen, from $3 to $4 per day; viewers, from $4 to $5 per day; chainmen, axemen, etc., from $2.50 to $4, the pay including necessary expenses in each case. It is further provided that referees must be qualified consulting civil engineers.

Government to Give 20,000 Motor Trucks to States

About 20,000 motor trucks, valued at more than $45,000,000 are to be distributed by the Secretary of Agriculture, through the Bureau of Public Roads, to the state highway departments. These trucks have been declared surplus by the War Department, and are being distributed to the states under the provisions of Section 7 of the Post-office appropriation bill. They must be used by the states on roads constructed in full or in part by Federal aid. All that the states are required to do to

obtain these trucks, which range in capacity from 2 to 5 tons, is to pay the loading and freight charges.

Of the total number of vehicles to be acquired, 11,000 are new and 9000 have been used, but all are reported to be in serviceable condition. They will be apportioned to the states only upon request of the state highway department and on the basis of the total number of requests received from the various states. The requirements of the Federal-aid law, under which these trucks must be apportioned, do not allow the Bureau of Public Roads to distribute trucks to counties or to individuals.

Army Camps Are Sold Cheap

Twelve Army camps, eight of them of the more or less temporary type used for National Guard concentration sites and four used for miscellaneous camps, have been sold for a total of $548,194.

Bids on these camps were noted in the "Business News" section of this journal, May 1, 1919. No statement has been given out as to the original costs of the camps, but they must have been forty or fifty times the selling price. Contracts awarded for the sale of the camps are shown in tabulated form on p. 292 of the Construction News Section of this issue.

The City of Montgomery, Ala., obtained Camp Sheridan; the State of North Carolina takes over Camp Polk. Other camps went to individuals and firms, except Camp Kendrick, New Jersey, which was withdrawn from auction, and is to be retained for the Navy. In the case of Camp Beauregard, Louisiana, the successful bidder must guarantee to the state without cost buildings and improvements sufficient for one regimental camping area for the use of the state troops. At Camp Hancock, near Augusta, Ga., the underground improvements must be left intact for the benefit of the community. At Camp Polk, North Carolina, the buildings were sold to the state for use in connection with the state penitentiary. To the City of Spartanburg, S. C., will be given the sewerage and water systems at Camp Wadsworth.

All of these camps had comparatively few buildings, the cost of construction going mostly into underground and ground work.

New Piers for Staten Island

Twelve new steamship piers for Staten Island are being designed in the Department of Wharves, Docks and Ferries of the City of New York. Two of the piers are ready for the contract advertisement and await only the appropriation of the Board of Estimate, having been authorized by the Sinking Fund Commission. The development is located on the eastern shore of the island, just inside the Narrows and between Clifton and Tompkinsville. Each pier will be 125 ft. wide and 1000 ft. long, with 300-ft. slips.

Program of Water-Works Association Meeting

Discussion of the present trend of prices and other economic subjects of current interest will engage an entire session of the annual meeting of the American Water-Works Association to be held in Buffalo, June 9-13, 1919, according to preliminary announcement of the program. In addition to papers on technical water-works subjects, a series of papers by United States Government officials and by manufacturers on the price situation will be read.

The first day of the meeting will be devoted largely to registration and to committee meetings. In the evening the Water-Works Manufacturers' Association will hold a reception at the Iroquois Hotel.

A. W. Kreinheder, commissioner of the Buffalo Board of Public Works, will deliver the address of welcome at the opening session on the second day of the meeting. He will be followed by John E. Teeple and John A. Kienle, who will speak on "The Relation of the Chemical Industry of Niagara Falls to the Water-Works." After this paper a round-table meeting will be held for the discussion of problems relating to operation and maintenance of water-works. Among the topics to be discussed will be "Damage to Fire Hydrants by Motor Vehicles, and Remedies Therefor." The afternoon session will include the report of the Private Fire Protection Service Committee, Nicholas S. Hill, Jr., chairman. In the evening the following papers will be presented: "Buffalo Water-Supply, With Special Reference to the Filtration Problem"; "Reduction of Water Consumption by Means of Survey and Constant Inspection," and "The Uniflow Pumping Engine," by D. A. Decrow.

The morning session June 11 will be given over to a discussion of economic and business subjects, and will be addressed by Government officials and manufacturers.

Other papers to be presented at the meeting are: "Purification of Water for the Army and Field Purification Plants," by William J. Orchard; "Air Lift and Water Purification," by John Oliphant; "The Effect of the War Period, 1914-1918, and Public Control Upon Water-Works of the United States," by Leonard Metcalf.

Minnesota Water-Works Meeting

Fire-supply connections as dangerous features of public water-supplies, sewage pollution, centrifugal pumps and aëration for water softening were the principal subjects presented at the semi-annual meeting of the Minnesota Section of the American Water-Works Association, held at the University of Minnesota, Minneapolis, May 3.

Papers relating to the first two subjects included "Water-Works for Fire Protection," by H. F. Blomquist, of St. Paul; "Features of Design in Small Water-Works," by F. H. Bass, of Minneapolis, and "Legal Responsibility for a Pure Water-Supply," by John Wilson, of Duluth. Resolutions were adopted opposing cross-connections between a polluted fire supply and a pure or purified public supply, and commending the state Board of Health for its work along these lines; also requesting the American Water-Works Association to appoint a committee to secure coöperation and standardization in the design of fire and domestic supplies, with a view to local or state control.

The remarkable results of a 30,000,000-gal. centrifugal pump at Minneapolis, with the economy of this large unit in regard to installation and operation, were the subject of a paper by F. W. Cappelen, city engineer. Water softening and removal of iron by aëration were discussed by J. A. Childs and L. I. Birdsall, who showed drawings of plants for removing iron from well supplies. Mr. Childs explained the need for this, as in small towns the people are apt to use a soft water readily available (but possibly polluted) in preference to a hard, iron-laden water supplied by the municipality.

Officers for 1919 were elected as follows: Chairman, H. F. Blomquist, of St. Paul; vice chairman, D. A. Reed, of Duluth. An invitation was extended to hold the fall meeting at Rochester, Minn.

Indiana State Highway Commission Selects Chief Engineer

Under the state highway law enacted by the last Indiana legislature the reorganized state highway commission has appointed H. K. Bishop, formerly district engineer of the Bureau of Public Roads, chief engineer. Mr. Bishop has had extensive experience in highway engineering, and in his position with the Bureau of Public Roads supervised all Federal-aid road work in Ohio, Pennsylvania, Maryland, Virginia, West Virginia, North Carolina and New Jersey. He was graduated from Cornell University, Ithaca, N. Y., in 1893, and after considerable experience in municipal, New York State Barge Canal and other public work, became one of the first deputy engineers of the New York State Highway Commission when it was formed in 1909. He continued in this position until 1911. Following this he went to Honolulu, Hawaii, where he laid out the boulevard system and became commissioner of the Honolulu board of public works. Shortly after returning to the United States he became district engineer in the Bureau of Public Roads. The salary of his new position will be $7000 per year.

Milwaukee to Develop Harbor

Municipal docks and freight terminals on Jones Island, in Milwaukee harbor, are under consideration by the city. The harbor commission has just retained H. McL. Harding, consulting engineer, New York, to have charge of the project.

Campaign on Foot to Organize Auxiliary Engineer Corps

Letters have been sent to a number of the civilian members of the United States Engineer Department urging upon them the advocacy of an Auxiliary Engineer Corps, which will apparently be a part of the Corps of Engineers of the Army. The letter states that a bill for this purpose has recently been placed in the hands of Senator Ransdell of Louisiana, with a view to having it introduced at the coming session of Congress. This bill provides for a complete organization of the engineers doing public work in the United States, but placing the new department under the Chief of Engineers, U. S. A., and providing military status for all of the members thereof. The head of the department would be the Chief of Engineers, with the rank he now has of major general, and the division engineers would have the rank of brigadier general, and district engineers the rank of colonel, with provision for military rank for all subordinate assistants. It is the intention, according to the letter, that the corps be mobilized from the experienced men now in the United States Engineer Department. It is also stated that the duties of the corps will be the control of the river and harbor work of the United States as well as the construction, care and maintenance of all public works, particularly highways and bridges.

The last paragraph of the letter says: "Strong influence is working to turn public works over to the Quartermaster Corps, because they have already so many of our men in the service, and there is talk of a waterways commission and a construction-engineer branch in the quartermaster service, but it is not believed that either the people or Congress are ready for a change of engineers. The Auxiliary Engineer Corps will meet any public necessity, if there is one, for a waterways commission. There is a chance for any engineer who knows anything about river and harbor work to get in, as it calls for men having this special qualification."

Lieutenant Stuart Missing Since January 18

The American Red Cross is making every effort to locate Lieut. William H. Stuart, son of Duncan C. Stuart, of 12 Maple St., Oneonta, N. Y., who has been missing since Jan. 18, when he was last seen in New York City.

Any information that may be obtained is requested by the Red Cross.

Lieutenant Stuart is 27 years of age. He arrived from overseas service in January, and went to Washington Jan. 13, and received his discharge. He returned to New York and was last seen in that city Jan. 18 at 7:30 p.m. He is a graduate of Colgate University, class of 1914, and did two years' post-graduate work at the Brooklyn Polytechnic Institute. He is 5 ft. 8 in. tall, has dark brown hair and blue eyes and a ruddy complexion. He has a brown mole on the left side of his nose. If in uniform he has three gold service chevrons on his sleeve, indicating 18 months' service overseas. He was wearing, when last seen, spiral puttees, and not the customary leather ones for officers. Information relative to him may also be sent to D. C. Stuart, at the address given above, or Thomas Blizard, chief of police of Oneonta, N. Y.

British Columbia Technical Union Formed at Vancouver

An organization was recently formed in Vancouver, B. C., for "professional technical men and their technical assistants." It is called the British Columbia Technical Union. It is in nowise to be classed with the labor trades unions, the founders assert, nor will it affiliate with the labor organizations. The membership, which includes many members of the Engineering Institute of Canada and other national engineering organizations, rose above 100 within a few weeks. About 60 are classified as civil engineers.

The general purposes of the union are: (1) To obtain adequate public recognition of technical work; (2) to establish scales of standard fees for consultants and obtain recognition of the same; (3) to obtain equitable remuneration for salaried technical men and their salaried technical assistants; (4) to secure the consultation and employment of local members of the technical professions for work in British Columbia and to discourage the importation of men for technical work when duly qualified men are available in the province; (5) to protect members of this society when handicapped by extraneous influence in the execution of their professional duties; (6) to coöperate with existing professional societies in furtherance of the above objects, and, while not interfering with their usual activities, to assist them in every legitimate manner which will tend to maintain or improve the efficiency, status and remuneration of the technical professions; (7) to protect the public by encouraging the employment of qualified technical men.

The secretary-treasurer for the coming year is Charles T. Hamilton, 510 Hastings St. West, Vancouver, B. C.

Cities to Save Colorado Railway

Mayors of several Colorado cities recently organized the Northwestern Colorado Tunnel Association, for the main purpose of preventing the threatened abandonment of the Denver & Salt Lake R.R. It will endeavor also to secure the carrying out of the project for the six-mile James Peak tunnel which will eliminate the high altitude, steep grades and snow troubles of the present high-level line through the Corona Pass. R. E. Norval, of Hayden, Colo., was elected chairman.

Civil Service Examinations

New York.—Junior assistant engineer, State Engineer and Highway Department, $1200-$1440 per year, May 24. Apply to State Civil Service Commission, Albany, N. Y. File applications before May 24.

New York.—Bridge designer, Public Service Commission, First District, $1501 to $2100 per year. Apply to State Civil Service Commission, Albany, N. Y. File application before May 24.

United States

For United States civil service examinations listed below, apply to United States Civil Service Commission, Washington, D. C., or to any local office of the commission, for form 1312.

Highway bridge engineer, $1800 to $2100 per year, junior highway bridge engineer, $1200 to $1600 per year, Bureau of Public Roads and Rural Engineering, May 21. File applications in time to arrange for examination at place selected by applicant.

Engineer in forest products, $1860-$3000 per year; assistant engineer in forest products, $1200-$1800 per year, Forest Products Laboratory, Madison, Wis., May 27. File applications before May 27.

Chief of road survey party, $1800 to $2100 per year, transitman for road surveys, $1200 to $1800 per year, highway draftsman, $1200 to $1800 per year, Bureau of Public Roads and Rural Engineering, May 29. File applications before May 29.

Senior engineer and senior architect, Interstate Commerce Commission, $1800-$2700 per year, June 10. File application before June 10.

Valuation engineer, $3600-$4800 per year, and assistant valuation engineer, $2500-$3600 per year; technical staff, income-tax unit, Bureau of Internal Revenue, Treasury Department. No date specified.

ENGINEERING SOCIETIES

The Master Builders' Association of Central Washington was formed recently with the following officers: President, D. L. Thacker; vice-president, Edward McWilliams; secretary, J. H. Corbett, and treasurer, Harry Boyer. The headquarters are at Yakima.

The Logansport, Ind., Chapter of the American Association of Engineers was recently organized, with the following officers: President, C. T. McGreevy; vice-president, Carl Lux; secretary-treasurer, Ralph Newcomer.

The Canadian Good Roads Congress will hold its annual meeting at Quebec May 20-22, at the time of the informal conference of the provincial ministers of public works and their deputies. In

Calendar

Annual Meetings

NATIONAL CONFERENCE ON CITY PLANNING; 19 Congress St., Boston; May 26-28, Niagara Falls and Buffalo.

AMERICAN WATER-WORKS ASSOCIATION; 47 State St., Troy, N. Y.; June 9-13, Buffalo, N. Y.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, 29 W. 39th St., New York; June 16-19, Detroit.

AMERICAN SOCIETY OF CIVIL ENGINEERS; 29 W. 39th St., New York; June 17-20, St. Paul-Minneapolis.

AMERICAN SOCIETY FOR TESTING MATERIALS; University of Pennsylvania, Philadelphia; June 24-27, Atlantic City, N. J.

AMERICAN CONCRETE INSTITUTE; 6 Beacon St., Boston; June 27-28, Atlantic City, N. J.

addition to technical papers there will be an exhibit of materials and road-building methods. The conference of provincial ministers is called to discuss the Federal-aid highway bill.

The Colorado Association of Members of the American Society of Civil Engineers held a regular meeting May 10 at which Milo S. Ketchum, dean of the College of Engineering, University of Colorado, spoke on "The Construction of the United States Government Explosives Plant at Nitro, W. Va."

The Engineering Society of Tulsa, Okla., was organized at a meeting May 1. The following officers were elected: President, J. C. Hughes; vice-president, E. H. Cornelius; secretary-treasurer, S. W. Mitchell.

The Savannah, Ga., Chapter of the American Association of Engineers recently elected the following officers: President, George O. Haskell; vice-presidents, W. J. Kehoe and Percy Sugden; secretary, G. A. Beldan; treasurer, W. A. Whitfield.

The Rochester, N. Y., Engineering Society will be addressed May 16 by E. A. Fisher on "Old Surveys of Rochester." A meeting will be held May 23, at which E. Blough, chief chemist of the Aluminum Co. of America, Pittsburgh, will speak on "Commercial Applications of Aluminum."

The Colorado Society of Engineers held a meeting May 2 at which W. R. Rosche spoke on "The Byproducts of Bituminous Coal and Their Production." A. L. Fellows showed samples of the concrete used in the concrete oil tankers under construction at Alameda, Calif.

The Sacramento, Calif., Chapter of the American Association of Engineers was recently formed. W. B. Carruthers is president, R. A. Bergman is vice-president, and H. A. Lathrop is secretary.

The Associated Engineering Societies of St. Louis held a joint meeting under the auspices of the St. Louis Branch of the American Society of Refrigerating Engineers, May 14. E. W. Gallenkamp, Jr., of the Pilsbry-Becker Engineering & Supply Co., presented a paper on "The Effect of Increased Condenser. Ice Can and Freezing Coil Surface on Power Consumption of Ice Plants."

The Engineers' Society of St. Paul held a meeting May 12, at which P. E. Stevens, consulting engineer who had charge of the expansion of the McDougall-Duluth Co.'s shipbuilding plant, spoke on "Building a Shipyard."

The Brooklyn Engineers' Club was addressed May 8 by Irving Blount, who read a paper on "Final Disposition of Garbage."

The Los Angeles Chapter of the American Association of Engineers was organized recently. E. G. Sheibley is president and J. C. E. McClure is secretary.

The Engineers' Club of Trenton called a meeting May 8 to discuss the proposed Assunpink Way project. Mayor Frederick W. Donnelly of Trenton introduced the subject, and a number of members participated in the discussion.

The Charlotte, N. C., Chapter of the American Association of Engineers was formed recently. J. A. Killian is president and G. T. Asbury is secretary.

The Allied Engineering Association of Charleston, S. C., will hold its next meeting May 19. The annual meeting will be held June 16. The regular meetings are held on the third Monday of each month.

The Louisiana Engineering Society held a meeting May 12 at which Prof. John Smith Kendall, of Tulane University, read a paper on "Jackson Square."

The Salt Lake City Chapter of the American Association of Engineers was organized recently. Maj. O. Simons has been elected temporary secretary.

PERSONAL NOTES

GAYLORD CUMMIN has resigned as assistant to the president, Kelsey-Brewer Co., public utility operators, of Grand Rapids, Mich., and will establish offices in New York City as a consultant in municipal and public-utility problems. Mr. Cummin's office will be located temporarily in the office of the Institute of Public Service, 51 Chambers St. Last year he resigned as city manager of Grand Rapids to enter the Kelsey-Brewer Co. He was previously city engineer of Dayton, Ohio.

LIEUT. H. J. WILLIAMS, Engineering Division, Ordnance Department, U. S. A., who recently received his discharge from the service, has been appointed engineer of the Beacon Falls Rubber Shoe Co., Beacon Falls, Conn. Before entering the service Mr. Williams was engaged in private practice in New York City as a consulting engineer, and was also a member of the faculty of the Pratt Institute, Brooklyn.

HENRY H. FOX, estimating engineer, contract department, Turner Construction Co., New York City, has been appointed a vice-president, with headquarters in New York.

MAJ. A. J. SACKETT, formerly chief engineer of the Mason & Hanger Contracting Co., New York City, and R. L. CANNIFF, formerly treasurer, Degnon Contracting Co., New York City, have incorporated the North Atlantic Construction Co., and will conduct a general contracting business under that name.

A. S. ADAMS, who during the war served as supervising engineer of construction, Camp Logan, chief engineer of construction, Ellington Field, Houston, Tex., and in other war work, has opened an office in the Union National Bank Bldg., Houston, Tex., for the private practice of engineering.

J. P. H. PERRY, manager of the contract department, Turner Construction Co., New York City, has been appointed a vice-president, with headquarters in New York.

M. L. LOEWENBERG, recently engineer, Worden-Allen Co., Chicago, and I. S. LOEWENBERG, formerly architect, Swift & Co., Chicago, have become associated under the firm name of LOEWENBERG & LOEWENBERG, engineers and architects, with offices at 29 S. LaSalle St., Chicago.

W. W. TURNER, president of the Turner Concrete Steel Co., has become a general manager of the Turner Construction Co., New York City, in charge of work in the vicinity of Philadelphia, with headquarters in that city. The Turner Concrete Steel Co. has been consolidated with the Turner Construction Company.

CAPT. JOHN F. DRUAR, Engineers, U. S. A., recently discharged from the service, and ROSCOE L. SMITH, recently engaged with the National Board of Fire Underwriters on water-supply and fire-protection work in Army camps, have become associated in partnership to engage in general engineering work, with headquarters in the Globe Bldg., St. Paul, Minn.

EDMUND F. SAXTON, formerly assistant director of the Department of Wharves, Docks and Ferries, Philadelphia, has become treasurer and a director of the John S. Boyd Co., Williamstown, Mass., succeeding Richard A. Strong, resigned. He will be in charge of the engineering work of the company.

MAX TOLTZ, head of the Toltz Engineering Co., W. E. KING, for several years treasurer and manager of

the Toltz Co., and BEAVER WADE DAY, recently engaged in the United States Housing Corporation project at Manitowoc, Wis., have become associated in partnership under the firm name of TOLTZ, KING & DAY, Inc., successors to the Toltz Engineering Co., at 1410 Pioneer Bldg., St. Paul. The new firm will carry on a general consulting and architectural engineering business, specializing in industrial structures.

A. C. SHUIT, who has concluded his work as cost engineer for the United States Housing Corporation on the project at Aberdeen, Md., has been appointed construction engineer, Washington Suburban Sanitary Commission.

THOMAS R. SPENCER, after thirty years' service with the Oregonia Bridge Co., Inc., Lebanon, Ohio, has resigned as general manager of the company, and is succeeded by Capt. A. H. ROBERTSON, JR., U. S. A., who recently received his discharge from the service and who was formerly chief engineer of the Dover Boiler Works, Dover, N. J.

T. V. STEVENS, formerly city manager of Cadillac, Mich., has resigned as senior engineer of the housing division, Emergency Fleet Corporation, to become associated with ALBRIGHT & MEBUS, consulting engineers, Philadelphia.

EDGAR I. WILLIAMS and WALTER R. MAHNKEN have become associated under the firm name of WILLIAMS & MAHNKEN, architects, 30 E. 42nd St., New York City.

A. C. TOZZER, general superintendent of the Turner Construction Co., New York City, has been appointed a vice-president and general manager of the New England territory, with headquarters in Boston.

C. W. L. FILKINS, of Scranton, Penn., has opened an office at Stockbridge, Mass., and will engage in civil engineering and construction work, in connection with his office in the Commercial Trust Bldg., Philadelphia.

C. T. JORDAN, district engineer, State Highway Department of Washington, has been placed in charge of the new office of the department in the County-City Bldg., Seattle.

CHARLES R. MCLAUGHLIN, Philadelphia, has been appointed engineer in charge of construction at the new Pennsylvania State Sanitarium at Mount Alto.

LOUVA G. LENERT, assistant state sanitary engineer, Bureau of Sanitary Engineering, Texas State Board of Health, has resigned to engage in private practice, with offices at Cisco and Breckinridge, Tex.

MORRIS R. SHERRERD, chief engineer of the Department of Streets and Public Improvements, Newark, N. J., has been appointed chief engineer of the North Jersey District Water Supply Commission, and will assume office July 1. It is understood that Mr. Sherrerd will continue his work for the city in the capacity of consulting engineer. Mr. Sherrerd first entered the employ of the City of Newark in 1895. He became engineer and superintendent of the Department of Water and in 1905 was appointed chief engineer of the Department of Streets and Public Improvements.

T. A. SMITH, general superintendent, Turner Construction Co., New York City, has been appointed a vice-president, with headquarters in New York.

H. D. JUDSON, of St. Joseph, Mo., M. S. MURRAY, of Sikeston, M. J. HANICK, of St. Louis, and H. D. GRIFFITH, of Hillsboro, have been appointed deputy highway engineers, Missouri State Highway Commission.

W. B. STEVENSON, acting city engineer of Fargo, N. D., has purchased the business and equipment of the Hopeman Engineering Co., Moorhead, Minn.

JOHN P. HARPER, first assistant state highway engineer of Arkansas, has resigned, and announces his intention of opening an office at Little Rock for the private practice of egineering.

W. E. LYLE, a general superintendent, Turner Construction Co., New York City, has been appointed a general manager in charge of work in western New York, western Pennsylvania, and eastern Ohio, with headquarters in Buffalo.

LYNN B. MILAM, of the firm of Thomas, Milam & Touchstone, attorneys at law, Dallas, Tex., has been appointed supervisor of public utilities of that city, succeeding M. N. Baker.

DONALD D. SNYDER, assistant engineer, Bureau of Engineering, Albany, N. Y., has resigned to become commissioner of public works and city engineer of Rutland, Vt.

A. W. STEPHENS, engineer, Turner Construction Co., has been appointed chief engineer, with headquarters in New York.

J. R. and R. L. BARRY have become associated under the firm name of BARRY & BARRY, civil engineers, Lawton, Okla.

HENRY WOOD, private secretary to Governor Robertson of Oklahoma, has been appointed state highway commissioner, succeeding George B. Noble.

R. C. WILSON, engineer, Turner Construction Co., New York City, has been appointed a general manager, with headquarters in New York.

EDWARD R. SCHOFIELD, draftsman, Bureau of Surveys, Philadelphia, has been appointed assistant engineer.

MAJ. JOHN R. FORDYCE, Engineers, U. S. A., who was constructing quartermaster at Camp Pike, and who recently received his discharge from the service, has announced that he will open an office for the private practice of engineering at Little Rock, Ark.

DR. OBADIAH C. BOGARDUS, Keyport, N. J., has been appointed a member of the North Jersey District Water Supply Commission.

M. D. GLESSNER, of Yuma, Ariz., has been appointed assistant to F. L. SELLEW in irrigation and dam construction in eastern Arizona near St. Johns

OBITUARY

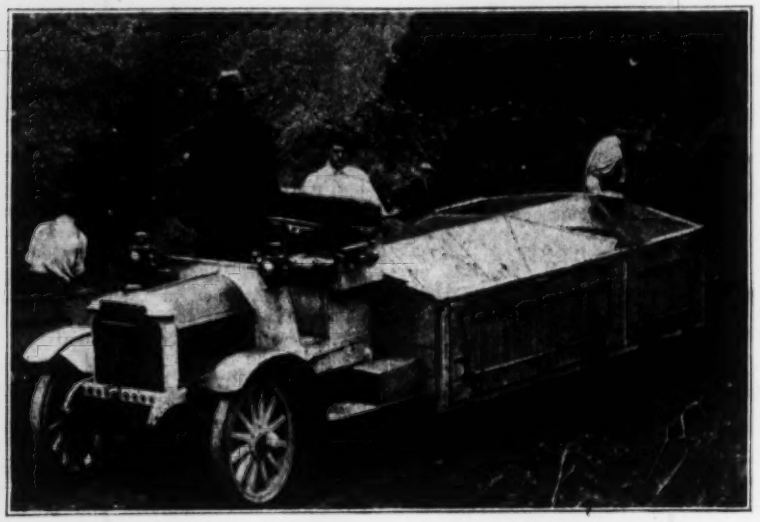
HOMER P. RITTER, hydrographic and geodetic engineer, United States Coast and Geodetic Survey, and member of the Mississippi River Commission, died in Washington, D. C., Apr. 21. He was born in 1850 and studied at the School of Mines, Columbia College, New York City. In 1880 he become United States assistant engineer, Mississippi River Commission on hydrographic and topographic surveys, remaining in Government service to the time of his death. He also served on international boundary surveys as official representative of the Government. In 1904 he commanded the steamer "McArthur," making a survey of Kiska harbor, Aleutian Islands, in the Bering Sea. In 1907 he was appointed a member of the board to investigate and report on the feasibility of a 14-ft. channel in the Mississippi River. In more recent years he was engaged in the revision of charts of New York harbor, Long Island Sound, and other waters.

ADNA DOBSON, city engineer of Lincoln, Neb., who had served in that capacity for 18 years, died May 4. He was born in 1857, and received his technical education in an engineering office. In 1878 he became deputy county surveyor, and afterwards assistant city engineer of Lincoln. After a brief period of private practice he was elected city engineer of Lincoln in 1891, and served four years, afterwards becoming under-secretary of the State Board of Irrigation of Nebraska. After engaging again in private practice for two years he was again elected city engineer of Lincoln in 1900 and again in 1909.

CARL UHLIG, engineer, California Board of State Harbor Commissioners, died in San Francisco May 5, at the age of 72. He had been connected with the engineering department of the Harbor Commission for over 42 years. In 1870 he became an assistant in the United States Coast and Geodetic Survey, four years later being appointed assistant engineer, water-supply office, San Francisco. In 1876 he became assistant engineer and chief draftsman, California Board of State Harbor Commissioners, and remained in the service of the board to the time of his death.

Sectional Truck Body for Hauling Road-Repairing Materials

A sectional, side-dumping motor-truck body for hauling gravel and other materials on road construction and maintenance is shown in the accompanying illustration. It is arranged with four pockets having two different capacities, so that a large or a small amount can be dumped as desired. The low box makes it easy to load the truck by hand shoveling.



LOW SECTIONAL TRUCK BODY IS EASY TO LOAD AND DUMP

In operation, the trucks are loaded at the gravel pit, having the trap doors in the sides held shut by straps on the lever road, which fit into iron slots on the floor of the truck. When the truck is loaded it proceeds to the road, and the compartments are alternately dumped at places and in quantities as desired by pulling the lever forward or back, as required. Free discharge of material is provided for by a peeked floor extending along the middle line of the truck box.

The illustration shows a two-ton Federal motor truck with one of these boxes, which was designed by J. A. Gould, road commissioner at Windsor, Vt. He has found this type of body particularly adapted to his purposes.

National Offices Opened by Trailer Manufacturers

National headquarters for the recently organized Trailer Manufacturers' Association of America, the organization of which was noted in *Engineering News-Record* of Mar. 6, 1919, p. 499, have just been established in New York City, in the World Tower Building, 110 W. 40th St. Matters of interest and importance to the industry will be considered and action will be taken regarding them—for example, ill-advised legislation affecting motor trucks and trailers in several states will be investigated.

It is felt that the opening of the New York headquarters marks a new era in trailer industry. From the new office will originate activities to familiarize the business world with the many applications of trailers to haulage problems and the economies to be effected thereby, with plans for the promotion of the best interests of highway transportation. Fourteen of the leading trailer manufacturers have already joined the organization, of which H. W. Perry, formerly with the National Automobile Chamber of Commerce, is general manager.

Business Notes

The Manufacturers' Sales Co., with offices at 914 American Bank Building, Seattle, Wash., has been organized by H. P. Hammond, of Seattle, to handle concrete products, Terrazzo flooring and building material specialties.

The Sterling Wheelbarrow Co., of Milwaukee, is erecting an addition to its plant, 385 x 165 ft. The new structure will accommodate a two-story office section, including a large display room.

The Bell Locomotive Works, Inc., 11 Pine St., New York City, announces that their former sales manager, J. Stanley McCormack, will return to his old position in the near future upon discharge from the Naval Aviation Corps.

The Joseph Dixon Crucible Co., of Jersey City, N. J., manufacturer of lead pencils and other graphite products, has removed its Philadelphia sales office from 1020 Arch St. to Rooms 801-802 of the Finance Bldg., South Penn Square. The manager of the sales office is W. G. Springer. The Crucible company and the American Graphite Co., a subsidiary, held their annual meetings Apr. 21. The following officers were elected for both companies: George T. Smith, president; George E. Long, vice-president. For the former company J. H. Schermerhorn was elected vice-president and William Koester treasurer; for the latter J. H. Schermerhorn was elected treasurer.

The Booth-Hall Co., designer and builder of electric furnaces, announces the removal of its executive and sales offices from 565 W. Washington Boulevard to Rooms 1007-1008, Hearst Building, 326 W. Madison Street, Chicago.

The American Steam Conveyor Corporation, of Chicago, announces the appointment of N. B. Stewart as district representative in charge of the St. Louis territory. Offices have been opened at 708 Merchants-Laclede Bldg., St. Louis.

The Union Bridge and Iron Co., Seattle and Portland, has been incorporated by Charles G. Huber, specialist in the design and construction of Luten design bridges, and George A. Sears, formerly of the Coast Bridge Co., Portland, Ore.

Trade Publications

The following companies have issued trade publications:

The Silent Hoist Co., 302-304 McDougal St., Brooklyn, N. Y.; leaflet, 4 x 9¼ in., eight pages, illustrated; describes its Model A, 20-hp. gasoline unit.

The American Steam Conveyor Corporation, 326 W. Madson St., Chicago, Ill.; pamphlet, 8½ x 11 in., 12 pages, illustrated. "Reducing Ash-Disposal Costs" is the subject treated.

The Deming Co., Salem, Ohio; catalog, 6¾ x 9¼ in., 37 pages, illustrated; covers vertical single-acting Triplex power pumps.

The John J. Macklem Scaffolding Co., Goshen, Ind.; catalog, 6 x 9¼ in., 16 pages, illustrated; shows details of, and describes method of using, sectional scaffolding.

The General Fireproofing Co., Youngstown, Ohio; catalog, 8 x 11 in., 16 pages, illustrated; contains data on the use of "Self-Sentering Trussit and Steel Tile," for roofs, floors, ceilings and partitions.

The Ball Engine Co., Erie, Penn., leaflet, 8½ x 11 in., four pages, illustrated. The subject is the cost of operating Erie steam shovels on road and street gradings.